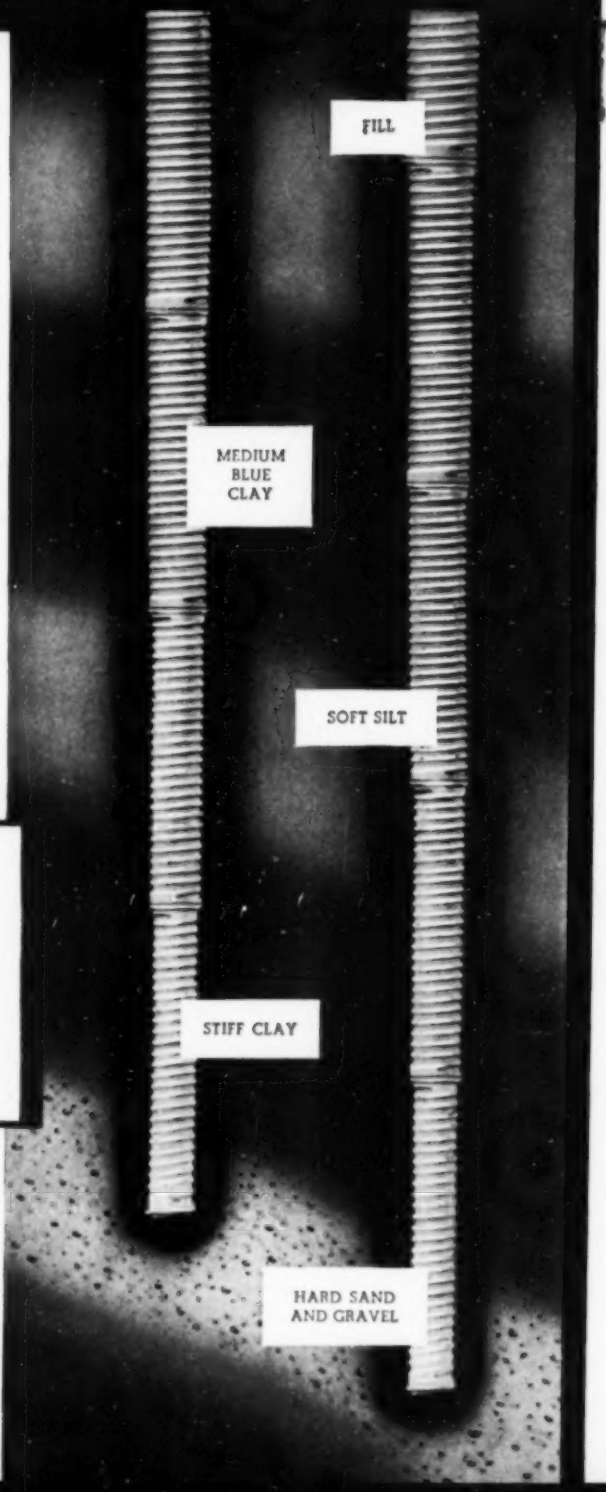
CIVIL ENGINEERING

Number three of a series . . . . ADVANTAGES OF RAYMOND CONCRETE PILES

uniform bearing capacity

THE COMPLETE FLEXIBILITY of Raymond Concrete Piles as to length permits all piles to be driven to a uniform resistance regardless of variations in depths of bearing soils. Raymond Piles are available in an endless variety of lengths through combining step-taper sections of different lengths or joining step-taper sections with pipe or wood lower sections. Because the piles are cast-in-place, time is saved (and cost reduced) by eliminating the driving of test piles to predetermine lengths, as well as eliminating the delay due to casting and curing of precast piles.

RAYMOND STEP-TAPER PILES, AVAILABLE IN SUITABLE LENGTHS, ARE DRIVEN TO UNIFORM RESISTANCE AND BEARING CAPACITY REGARDLESS OF SOIL CONDITIONS.



RAYMOND CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

Branch Offices in Principal Cities of the United States, Central and South America

RAYMOND'S DOMESTIC SERVICES

Soil Investigations • Foundation Construction
Harbor and Waterfront Improvements
Prestressed Concrete Construction
Cement-mortar Lining of Water, Oil and Gas Pipelines In Place

RAYMOND'S SERVICES ABROAD

In addition to the above, all types of General Construction.

AROUND THE WORLD FOUNDED 1901

THERE'S NO SAFE SUBSTITUTE . . .

Clay Pipe Sewerage MUST Keep Pace With Every Growing City!

Public officials in the Greater Minneapolis area know how important safe sanitation is to fast-growing new residential areas. This one project alone—the Ardmore addition to the city's southwest borders—calls for 7,892 feet of Clay Pipe. Another $4,000,000 project in the suburb of Richfield will require an estimated 100 miles of Clay Pipe. The Richfield project will be handled by the G. M. Orr Co., consulting engineers, under the supervision of Robert Huston, design engineer.

Throughout the nation, Vitrified Clay Pipe is solving vital sewerage problems of areas confronted with "growing pains." Here are just a few of the reasons for this overwhelming preference for Clay Pipe:

PUBLIC OFFICIALS know that Clay Pipe is guaranteed for 50 years. It's a guarantee of safety and performance that is especially important when sewerage and drainage facilities are financed by bond issues.

ENGINEERS are assured their professional reputations will be enhanced by years of trouble-free service, because Clay Pipe can't be corroded by acid waste or sewer gases.

CONTRACTORS know they can count on Clay Pipe for fast, easy installation and ready availability.

The manufacturers of Vitrified Clay Pipe work constantly to make this fine product even better through research and testing. You can be sure you're getting the latest and the best when you specify Vitrified Clay Pipe. It's performance-proved . . . precision-produced . . . and permanently safe!

Vitrified CLAY PIPE

GLAZED INSIDE AND OUT NEVER WEARS OUT!

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C-254-1

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Table of Contents is on page 39

CHECKING ALIGNMENT of the turbine throttle valve with Berger 6" Transit; grade set with Berger Level. Tolerances 1/32" in any direction.

ESTABLISHING GRADES for setting reclaim hopper with Berger Level.

CHECKING TURBINE GENERATOR to elevation within ±1/32" with a Berger Level.

From project base line to complete power plant installation...

Berger Instruments point the way for Stone & Webster engineers

"In laying out a power plant like this for The Hartford Electric Light Company, 1/32" is a critical dimension – whether you're establishing the initial project base line or aligning the turbine throttle valve – because all buildings and equipment must be accurately integrated into one operating unit," say the field engineers at Stone & Webster Engineering Corporation.

Berger Transits and Levels were used exclusively on this job – to meet these requirements:

All building base plates set for line and grade within a tolerance of 1/32".

Anchor bolts for coal handling equipment set to 1/16" to assure perfect fit in field erection of prefabricated sections.

Alignment and elevation of main and auxiliary steam lines set under strain within 1/16" in order that they will assume their proper position after expansion takes place when lines become operative at a temperature of 950° F. Deviation from dead level held within ±1/32".

Center lines for all equipment — piping, generators, boiler feed pumps, pulverizers, condensers, etc. — must be accurately related to one set of base lines.

Rails for 120-ton overhead bridge crane 97'6" apart must be truly parallel within 1/16" and set accurately at required distance.

Berger Instruments were on the job here, as they are on so many other Stone & Webster projects. For when the "specs" call for really close-tolerance construction, leading engineers and construction men buy Berger . . . Take one into the field and see why. *Count on quick delivery—thanks to enlarged capacity.*

C. L. Berger & Sons, Inc., 37 Williams Street, Boston 19

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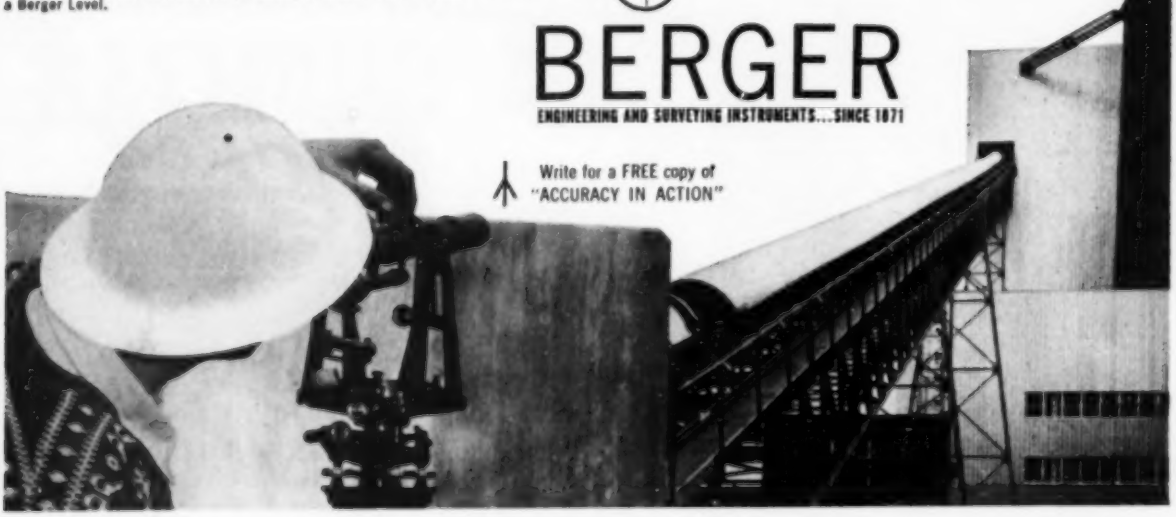


You are standing at the bottom of a lake!

The lake isn't made yet, but when it is filled it will be the Garza-Little Elm Reservoir on the Trinity River in Texas. The outlet-works for this great flood control and water storage project stands before you. It will protect the Trinity River Valley for 300 miles to its mouth in Galveston Bay.

Four 60- by 84-inch Rodney Hunt cast iron bronze-mounted sluice gates with Rodney Hunt hoists control the low-discharge flow of this huge outlet works rising 75 feet (not counting tower) above present ground level. The Rodney Hunt gates operate under heads of 25 to 48 feet.

Specify Rodney Hunt for Sluice Gates and Hoists of superior quality . . . over 2000 combinations of standard types and sizes available . . . and send for our 232-page profusely illustrated catalog. A special 28-page section gives valuable hydraulic engineering data. Write on your letterhead for Catalog WCA 952.

RODNEY HUNT MACHINE CO.
Water Control Apparatus Division
86 Lake Street, Orange, Mass., U.S.A.

RODNEY HUNT

Manufacturing Engineers Since 1840

MOTORISTS SAVE 10 TO 30 MINUTES crossing from Norfolk to Portsmouth via the new G-E equipped bridge and tunnel. Bridge is 4-lane, 2135 ft between abutments. Bascule span is of the double-leaf, rolling-lift type with leaves each 90 ft long.

Bridge's drive system helps speed 29,000 cars per day

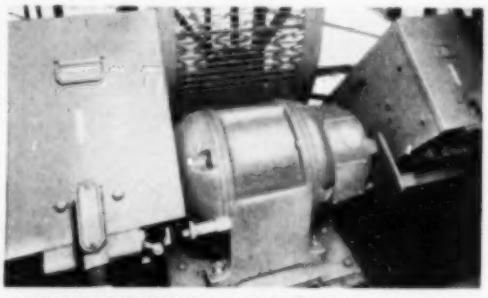
G-E equipment at Portsmouth - Norfolk Bridge gives fast movement, positive control of leaves

The new 4-lane bascule bridge across the Elizabeth River at Norfolk, Va.—part of a combined bridge and tunnel project built for the Portsmouth–Norfolk Bridge Tunnel Commission—is currently handling over 29,000 vehicles per day. Ability to handle this heavy traffic flow is due in part to electric equipment supplied and co-ordinated by General Electric.

In helping to develop the bridge's drive system, G-E engineers worked closely with J. E. Greiner Co., consulting engineers, Tidewater Construction Corp., engineers and contractors, and Tuck and Kendall Inc., electrical contractor. Result of this co-operation: a simple, dependable drive system that expedites traffic because it is easy to operate and provides positive-action control of bridge leaves for fast movement and smooth, safe seating.

This is one more example of how G-E engineers can help your engineers or consultants on electric equipment for heavy construction projects. For other examples of how G-E application engineering has been utilized on many of the important bridge "firsts" throughout the country, contact your local G-E Apparatus Sales Representative or write for a copy of GED-1982. General Electric Co., Schenectady 5, New York. 864-26

POSITIVE-ACTION CONTROL of span motors is centered in this G-E operator's desk. Fine-scale selsyn dial pinpoints position of each leaf during seating.



EACH LEAF IS MOVED by 2 G-E 25-hp motors (one shown). G-E motor control center, operated from desk, controls these and tail locks, gates, barriers.

Engineered Electrical Systems for Heavy Construction

GENERAL ELECTRIC

3 Large Fabricating Shops each one fully equipped

to fabricate and erect a variety of buildings

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ALLIED STRUCTURAL STEEL COMPANIES

Engineers • Fabricators • Erectors

20 NORTH WACKER DRIVE, CHICAGO 6, ILLINOIS

PLANTS IN

CHICAGO, ILLINOIS

HAMMOND, INDIANA AND

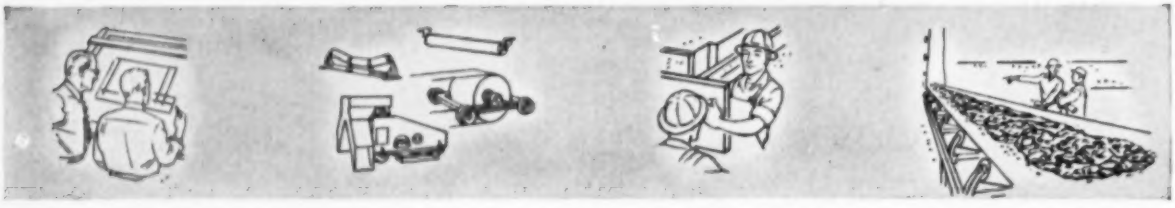
CLINTON, IOWA

BEAT HIGH TRANSPORTATION COSTS--

carry the load via belt conveyors

Exemplifying "total engineering", this Link-Belt roller bearing belt conveyor system moves earth over more than a mile of rugged terrain, from borrow pit to dam construction site.

LINK-BELT offers you the "total engineering" so necessary for top efficiency



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Because of its unrivalled experience, Link-Belt can do a better job of gathering and analyzing all data. Proposals reflect this understanding of the most practical way to fit conveyors into your system requirements.

BUILT FOR LONG-LIFE PERFORMANCE

Link-Belt manufactures all components and related feeders and conveyors. You are assured of the right equipment because of this breadth of line. And Link-Belt will supply the highest grade belts engineered to the job.

DELIVERS FULL RATED CAPACITY

Link-Belt follows through on every detail of the job, including electrical controls and even wiring and foundations. What's more, Link-Belt will furnish experienced erection superintendents, staffs and skilled crews.

ASSURES SATISFACTORY PERFORMANCE

When you rely on Link-Belt as a single source for your complete system, Link-Belt accepts responsibility for placing it in full operating readiness. We will also supervise modernization of existing systems.

Next time you're in the market for one belt conveyor or a complete system, call a conveying expert in the Link-Belt office near you. It's his job to help you get the best in belt conveying at the lowest possible overall cost.

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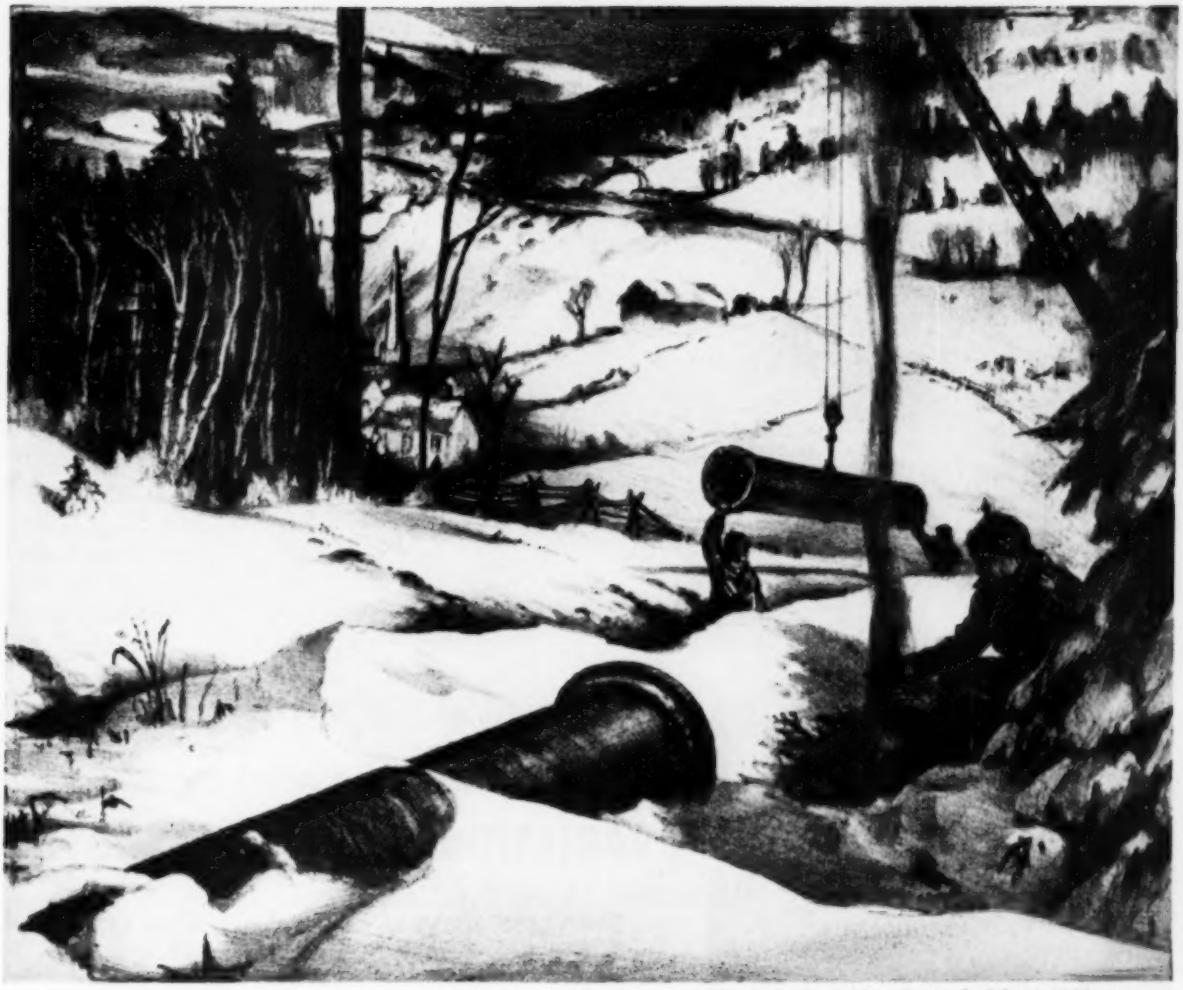

Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

WINTER OR SUMMER, in the hills or on the flats, make no difference to cast iron pipe. Whether it is used for a water supply line, a gas feeder main or a pressure sewer, cast iron pipe has a rich history of highly satisfactory performance behind it for each type of service.

U. S. pipe centrifugally cast in metal molds up to 24-inch, pit cast pipe in the larger sizes and fittings are made in accordance with Federal, American Standard and American Water Works Association specifications wheresoever they apply.

With our production distributed in five strategically located plants, we are in an excellent position to meet your requirements.

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cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE

Field assembly of Monotube piles is quickly and easily accomplished using a "come-along" with two cable chokers.

Driven pile being cut off at proper height. Use of cut-off sections as extensions minimizes waste.

Welding extension to driven base section of pile on right while driving of pile on left continues. No lost time.

How **MONOTUBE PILES** meet the need for **VARIATION IN DRIVEN LENGTHS**

UNLESS you've already had first-hand experience with Monotube piles, you might be amazed at how their "easy field extendibility" pays off. Engineers and contractors are taking advantage of it on job after job . . .

Many contractors set up a simple welding rack to do their own field assembly right on the job, thereby furnishing the driver with one-piece piles to approximate required length.

Another procedure is to weld on extensions as driving progresses. While one pile is being extended, driving continues on an adjacent pile. No lost time.

Such practices are completely practical with Monotubes because they combine light weight and easy handling with cold-rolled high strength. Weld-splicing goes easy and fast. No difficult welding operations.

Get the facts on *all* cost-important Monotube features. Write to The Union Metal Manufacturing Co., Canton 5, Ohio.

Monotube Foundation Piles

UNION METAL

A Service

that knows no boundaries

From Alaska to Zamboanga and points North, East, South and West, wherever man has a need for water—there you will find Layne.

It's a typical American success story—this history that spans nearly three quarters of a century and started with a one man muscle power drilling rig—and an idea.

Today Layne is the name of a product—but it's more than that—much more. The name Layne is also the name of a service, international in scope, that includes every phase of ground water development from preliminary exploration to maintenance of installed equipment.

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Water Wells • Vertical Turbine Pumps • Water Treatment

AMERICAN BRIDGE spans the Hackensack again!

HACKENSACK RIVER BRIDGE BETWEEN JERSEY CITY AND KEARNY, N. J.

Owner: New Jersey State Highway Department.

Specifications: New Jersey State Highway Department.

Consulting Engineers: Hardesty & Hanover.

Fabricated and Erected by American Bridge.

Providing broader roadways and wider channel, new structure on U.S. Routes 1 and 9 between Jersey City and Kearny speeds highway and river traffic!

SPANNING the Hackensack is getting to be a habit with American Bridge. We've done it twice in less than two years. Completing in 1952 a 5613-ft. structure with a 375 ft. plate girder main span on the N. J. Turnpike near Laurel Hill, N. J.; and this year, building a new bridge over the same river on heavily travelled U. S. Routes 1 and 9 between Jersey City and Kearny for the New Jersey State Highway Department.

Replacing a lighter, narrower bascule bridge, the new wider, higher Hackensack River Bridge is an important contribution to both highway and river traffic in this busy industrialized area. The new bridge increases the channel width and shortens operating time and traffic delays.

Carrying two 36-foot roadways, a 4-foot center mall, and two 6-foot sidewalks, this 1,480-ft. bridge is dominated by a 222-ft. thru truss lift span that is supported by towers 149′ high and 81′4″ wide. Seven thousand tons of structural steel were used in the bridge, all of which was fabricated and erected by American Bridge.

These Hackensack bridges are recent examples of American Bridge engineering, fabricating and erecting "know-how." If you would like to know more about the advantages of American Bridge construction, contact our nearest office.

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION, GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.

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AMERICAN BRIDGE

USS

UNITED STATES STEEL

Allis-Chalmers Powerful HD-15 adds to its big work advantages

. . . now offers choice of two outstanding drives — standard transmission with time-saving shift pattern, or widely accepted hydraulic torque converter drive

From its introduction, the Allis-Chalmers HD-15 has set new standards in performance and long-life service . . . in a new size class. It combines outstanding strength and balance with plenty of power, plus a simplified, time-saving transmission that gives big work output. In addition, the HD-15 offers remarkable service simplicity, with features like unit assembly and 1,000-hour lubrication intervals for truck wheels, idlers, and support rollers. It has proved itself the kind of tractor required on today's jobs.

Now, hydraulic torque converter drive is added as optional equipment — an additional working advantage for the powerful HD-15. This advanced design drive was introduced by Allis-Chalmers in the world's *first* torque converter tractor nine years ago. This modern drive gets more done because it automatically provides the right combination of speed and pull every working minute . . . and hydraulic cushioning assures longer life for both tractor and auxiliary equipment.

Now you can choose the HD-15 with standard transmission *or* hydraulic torque converter drive. Either way you'll be getting the most advanced tractor in the business. Let your Allis-Chalmers dealer give you *all* the reasons why.

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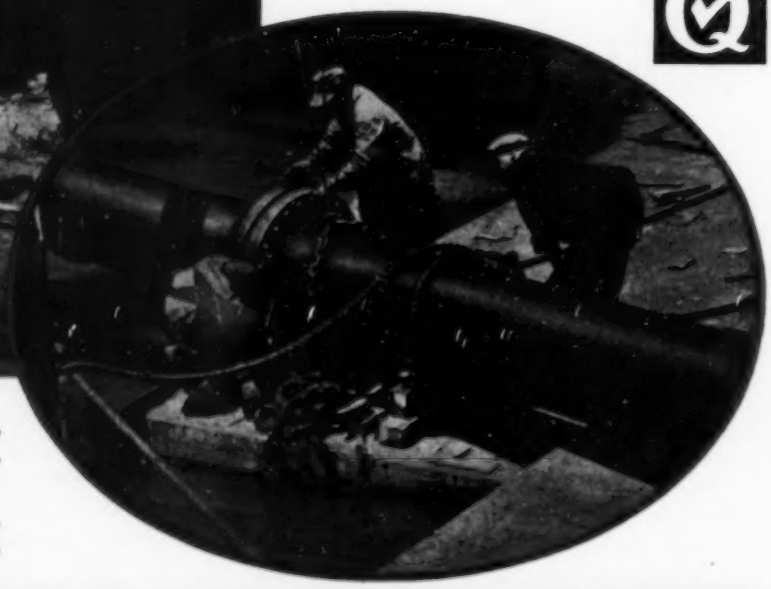
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

TORQUE CONVERTER

Symbol of greater output, longer life.

Versatile-

You know, of course, that cast iron pipe is widely used for water and gas mains, pressure sewers and outfalls, and almost exclusively in water filtration and sewage treatment plants. It is not so well known that this versatile pipe is also rendering yeoman service to Industry in keeping down maintenance cost in many applications. Such industries, for example, as chemical, paper, rayon and other process industries; coal mines and oil refineries; railroads and steel plants. Where effective resistance to corrosion is mandatory for long life and economy, specify cast iron pipe. For information write: Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Ill.

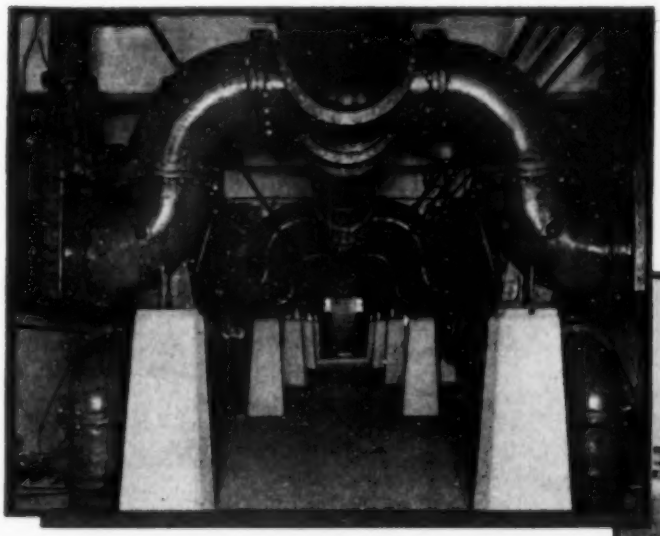


1800 feet of 36" to 60" cast iron pipe for culvert in connection with relocation of railroad tracks in Wyoming

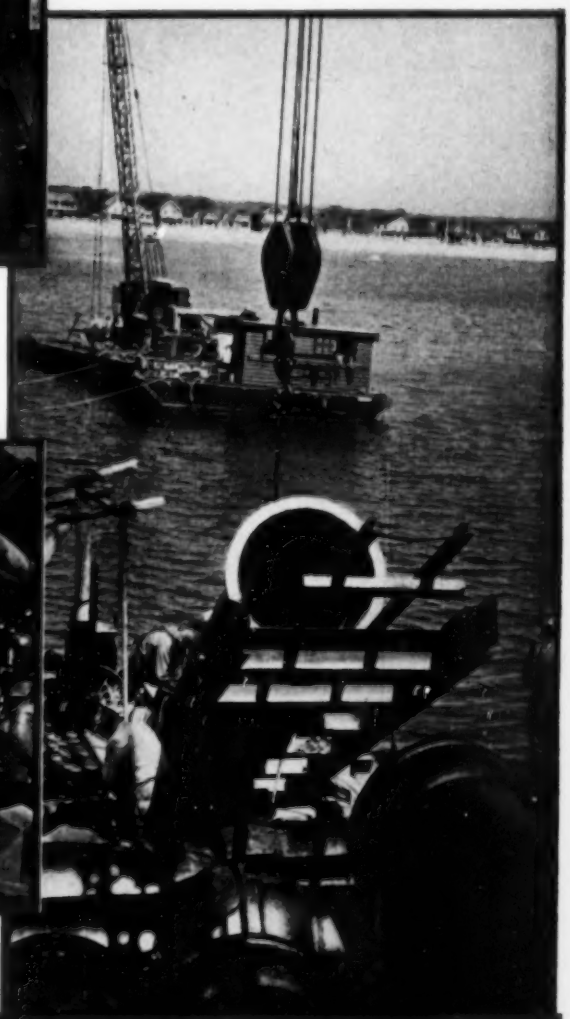
(At right) A river-crossing cast iron water line near Chester, Pa., showing flexible joint assembly.

CAST IRON PIPE

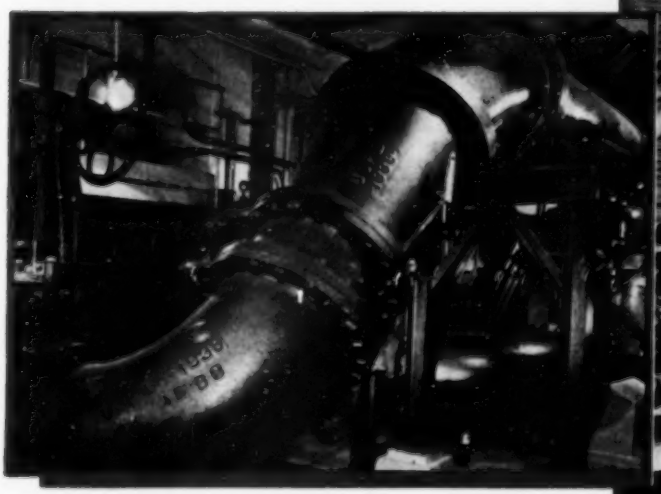
is the word for CAST IRON PIPE



Cast iron pipe and fittings installed in gallery of water filtration plant in Muskegon, Michigan.



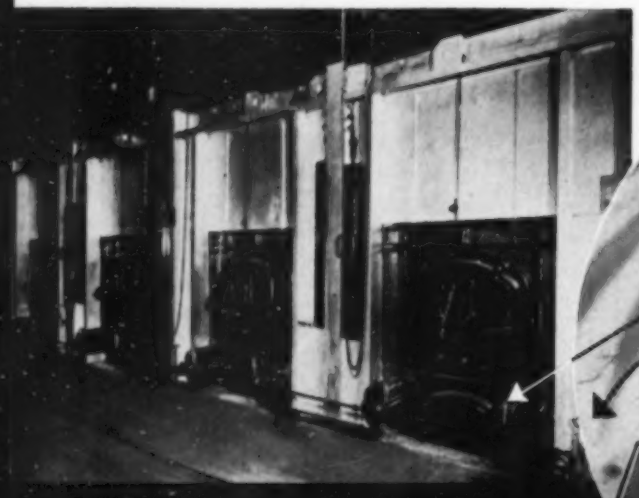
Submarine installation of cast iron flexible joint pipe for outfall sewer into Long Island Sound at Fairfield, Conn.

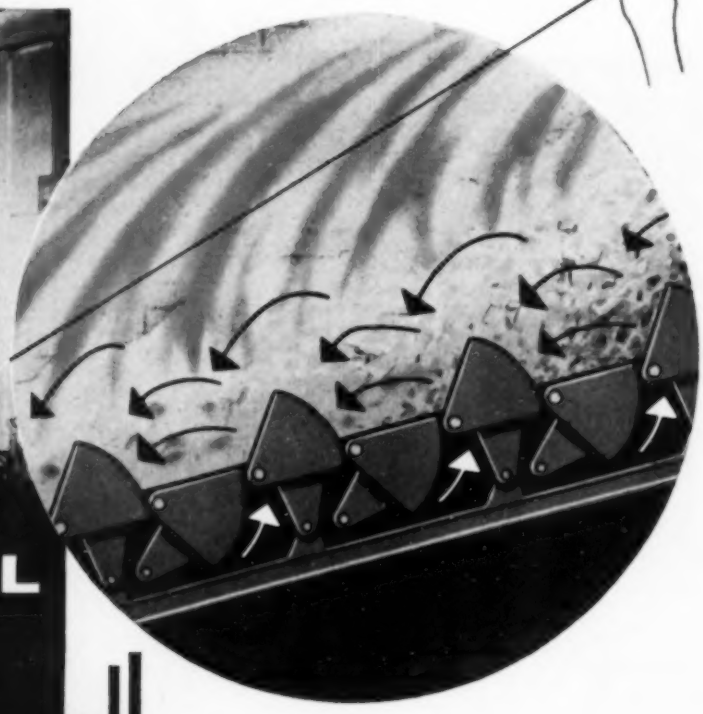


Installation of cast iron pipe and fittings in steam plant of a gas and electric utility in California.

SERVES FOR CENTURIES . . .

NOW at the throw of a handle





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PITTSBURGH-DES MOINES Incinerator

providing

- Up to 50% Greater Capacity
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- Reduced Labor
- No Clinkering
- Continuous Operation
- Uniform Temperatures
- Quicker Drying
- Lower Maintenance
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A broad advance in the efficient disposal of refuse is now provided by Pittsburgh-Des Moines' hydraulic stoking system. This system is available for new incineration plants, or for the reconversion of existing P-DM plants—providing up to 50% gain in capacity with present furnaces.

In operation, movement of a control handle raises and lowers segments of the burning hearth—causing a free, cascading, forward motion of the charge over the grates. This action prevents clinkering, speeds burning rate, avoids odor-producing drops in temperature, greatly reduces manual labor.

Consult with us on field-proved, thoroughly-tested P-DM hydraulic stoking. Write for a discussion, today.

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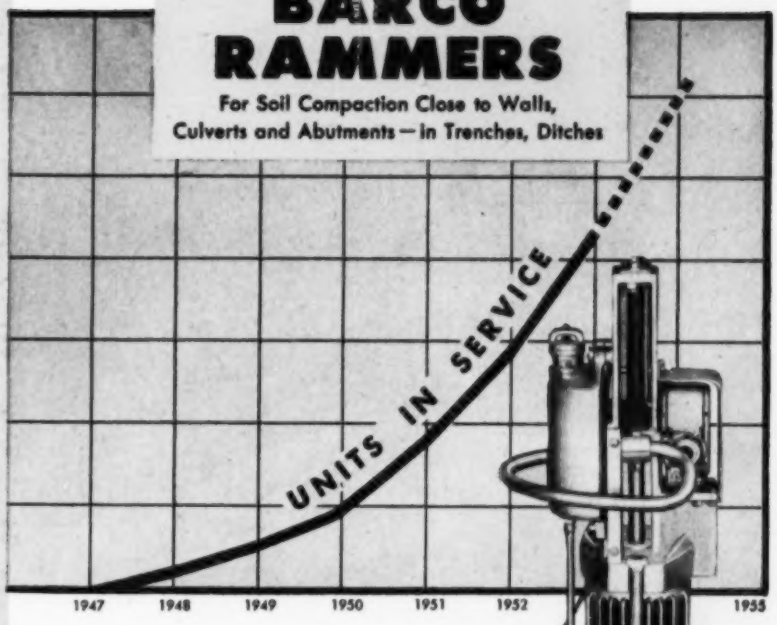
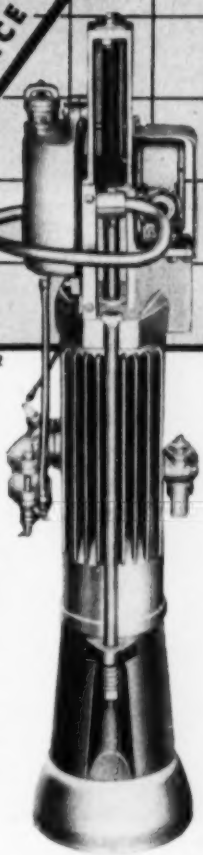
BARCO RAMMERS

For Soil Compaction Close to Walls, Culverts and Abutments — in Trenches, Ditches





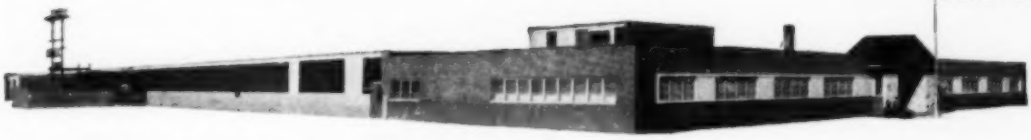
NO RECENT TREND in construction engineering has had a more phenomenal growth than the specification of HIGH DEGREE SOIL COMPACTION for all kinds of projects — Atomic Energy, Hydroelectric Power and Flood Control Dams, Highways, Toll Roads and Freeways, Airports, Bridges, Buildings, and Housing Developments!

The key to high degree compaction is the BARCO RAMMER — the first choice of experienced contractors everywhere. In test after test, the Barco machine delivers 95% to 97% compaction EASILY, EFFICIENTLY, ECONOMICALLY.

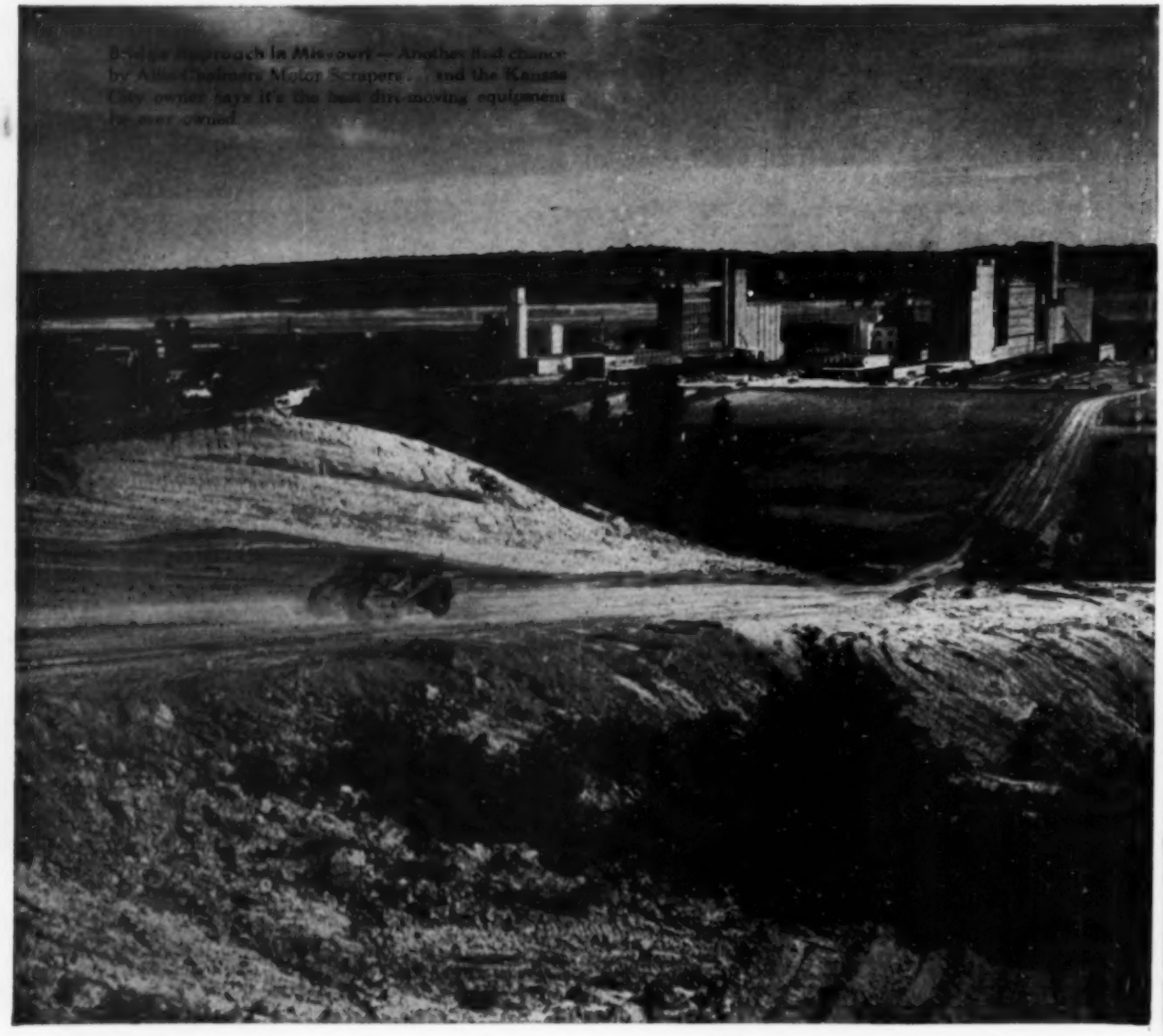
To meet the demand for Rammers, Barco has steadily boosted production schedules in a new and ultramodern plant. You are assured QUICK DELIVERY in 1954. *Send for latest technical bulletin on Soil Compaction and Barco Rammers.* BARCO MANUFACTURING COMPANY, 561D Hough Street, Barrington, Illinois.

These cylinder bodies are being used in early 1954 shipments of BARCO RAMMERS. All machining, assembling, and testing of Rammers is handled in Barco's new Barrington, Illinois, plant shown below.

- SELF-CONTAINED
- PORTABLE
- ONE MAN OPERATION
- FASTER COMPACTION
- BETTER COMPACTION
- LOWER INITIAL COST
- LOW OPERATING COST
- EASY TO USE, SAFE!



NOW! QUICK DELIVERY FROM FACTORY STOCK!



Today's Contractors are Keen Judges of Equipment

On earth-moving jobs all over the country, design, performance and service features that were once taken for granted are now getting a careful look . . . because even one extra yard per load, one extra mph. on the haul road can make a big difference when it comes to staying within bidding estimates.

That's why you see Allis-Chalmers Motor Scrapers and Motor Wagons on more and more big construction projects like those illustrated here. Cost-conscious, profit-conscious contractors have analyzed them, used them and have satisfied themselves that Allis-Chalmers Motor Scrapers have what they need to help them win bids, stay on schedule and make a profit when they are through with the job.

If you have your sights set on some close-margin, hard-to-get business, we *know* it will pay you to go over *all* the facts with your nearby Allis-Chalmers dealer.

Housing Project in California — Here, six big TS-300's and their HD-20 partners team up at the Westlake job near San Francisco . . . for a contractor moving over 8,000,000 yards in the last five years.

Runway Extension in Tennessee — This TS-300 is the first Allis-Chalmers equipment this contractor has ever owned, but it earned a regular spot fast by high-balling capacity loads like this trip after trip.

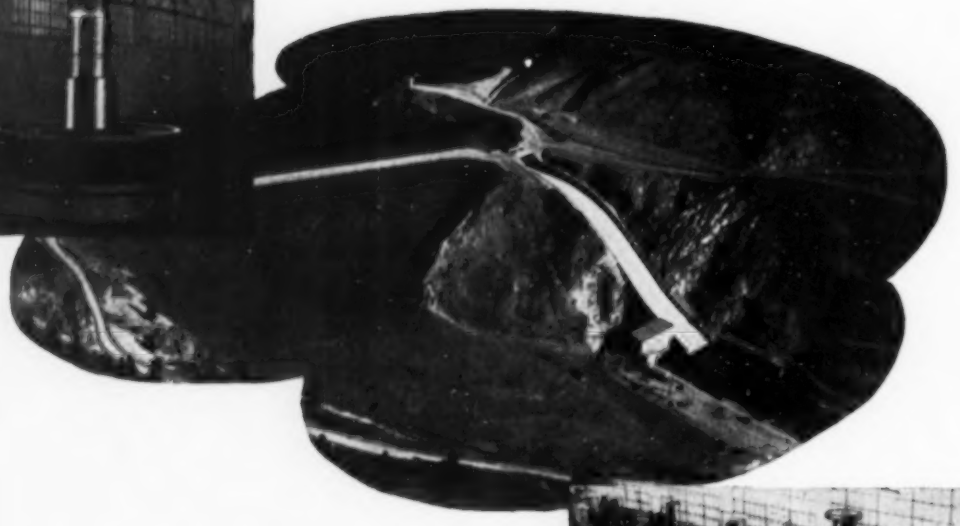
Dam-Building in Illinois — and the fleet color is Persian Orange. The 176 hp. TS-200's and HD-20's load smoothly, efficiently . . . and the TS-200 is rolling fast toward the fill the instant they break contact.

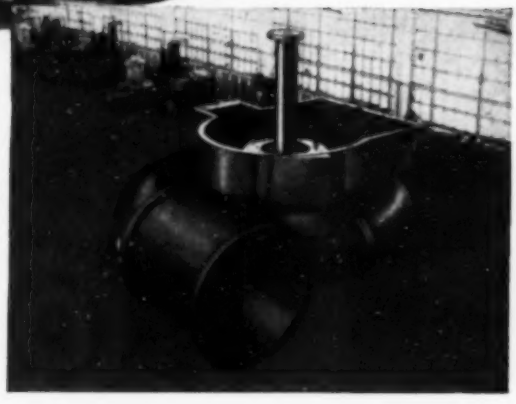
Railroad Bed in Montana — These TS-300's (14-yd. struck capacity; 18-yd. heaped capacity) averaged 14 trips an hour, excavating grade for a five-track rail bed at the site of a new aluminum plant.

Jet Base in Jersey — Silt and sand make this a tough job . . . but the extra power of the TS-300's, plus the HD-20's ability to exert full power at creep speeds, paid off in big yardage.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

The *"Anderson Ranch"* POWER PROJECT
United States Bureau of Reclamation





hydraulic turbines by **LEFFEL**

Anderson Ranch Dam, located on the Boise River in Idaho, U. S. A., is the highest earth-fill dam in the world. Two Leffel turbines are installed in the Anderson Power Plant which provides power for the surrounding area. The turbines are of the cast steel spiral case, vertical Francis type and each is maximum rated at 28,250 HP, under 324 ft. net head, speed 277 RPM.

With a structural height of 456 feet, a base width of 2,650 feet and a crest length of 1,350 feet the Anderson Ranch Dam contains nearly 10,000,000 cubic yards of earth and rock. The reservoir behind the dam will hold 493,200 acre-feet of water.

When you consider turbines for your power project (whether it is a new installation or the expansion of an existing installation) we ask you to keep in mind the services which are offered by Leffel. Our 92 years of experience, our large modern plant, our thorough workmanship — all are ready to serve you.

1083

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPARTMENT C • SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT HYDRAULIC POWER FOR 92 YEARS

NOW!

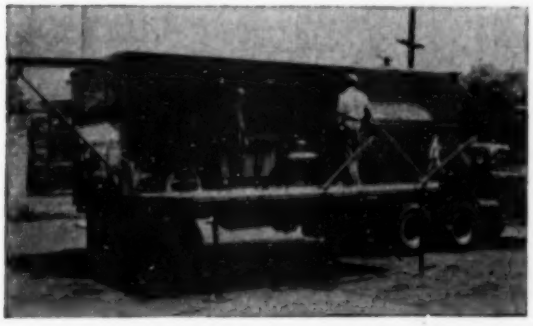
you can get big drill performance with the

CHALLENGER
Blast Hole Drill

HERE'S WHAT USERS SAY:

"Drilling cost per ton of ore broken reduced by two-thirds over wagon drills. Driller experience can further reduce to one-sixth of wagon drilling cost."

"Punched down four 60′ holes, bottoming at 4″ dia., in one shift. What a drill!"



SPECIAL DRILL AND STEEL SERVICE

The size of the Challenger Drill and the sectional steel used with it, makes necessary special drill and steel service which is provided by Joy. Service trucks, like the one shown here, make periodic visits in areas where Challenger Drills are operating. The operators of this "mobile shop" are experienced drill doctors who furnish complete drill steel service, bit sharpening service, drill inspection, and suggestions for use and application of the drill for best results.

Users' reports on early units show that you really get big drill performance with the Challenger Drill. It's a 5¼" hammer drill (not a piston drill) that drills 4½" diameter holes through hardest rock to depths of 50′ or more. This big drill performance calls for a 26′ feed to cut the number of steel changes, and a self-propelled mounting. Tractor-mounted on rubber tires with a portable compressor to furnish air for drilling, the Joy Challenger is the biggest cost-cutting big drill for hard rock drilling. Check your needs . . . see if this big drill won't answer your problems. ● ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Consult a Joy Engineer

JOY

WORLD'S LARGEST BUILDER OF CORE DRILLS, ROTARY BLAST HOLE DRILLS AND MOTORIZED DRILL RIGS

W&D C 4936

EIMCO

WORLD'S FINEST TRACTOR EXCAVATOR

HYDRAULIC TORQUE CONVERTER WITH UNIDRIVE TRANSMISSION—AN EXCLUSIVE FEATURE ON EIMCO TRACTOR EXCAVATORS

When hydraulic torque converters were first used in heavy prime moving equipment it marked a step forward in tractor design. But now the hydraulic torque converter with the Eimco Unidrive transmission provides the ultimate in heavy tractor drives and the ideal combination for effortless operation, longer life through cushioned load, increased work output and maximum operating efficiency.

The Eimco 105 is the only crawler tractor with the maneuverability permitted by hydraulic torque converter and Unidrive transmission.

This combination of mechanical ingenuity makes the 105, a 17 ton brute, as agile as a kitten. You can dance right, left, forward, backward without stopping to shift, without scraping a track pad.

The Eimco 105 matches all load conditions with exactly the right combination of speed and power and is capable of exerting maximum draw bar pull AT ALL TIMES.

It is the only crawler tractor in which the operator can change gears under full load, on grades or uneven terrain without stopping, losing position or dropping the moving load.

The 105 develops more drawbar pull per engine horsepower than any other tractor.

The 105 is the only tractor designed for the heavy attachments ordinarily used on tractors today. This extra strength built into the 105 is designed to

WITH COST SAVING ADVANTAGES

absorb the extra vertical loads into the main frame permitting all auxiliary equipment to be attached to the frame and leaving the tracks free to oscillate on uneven ground.

105s are made of heavy fabricated or cast alloy steel parts throughout. All gearing, bearings and shafts are oversize for years of uninterrupted service. All parts are easily accesible for quick service. Clutches never need adjustment. Timken tapered roller bearings are separately caged in track rollers, idlers and final drives for perfect alignment, accurate fit and long life.

The Unidrive transmission is a compact, complete unit, containing all the gearing and clutches for speed changing and full independent reversal of each track. This design combines all of the best features of constant mesh gearing and hydraulically operated friction clutches with sealed oil bath pressure lubrication of all wearing parts.

The independent control of each track, made possible by the Eimco Unidrive transmission, is another exclusive feature. Two separate final drives, one for each track, have extra heavy alloy steel gearing and extra large diameter shafts. There are no clutches, brakes or gadgets in the Eimco 105 final drives.

The operator of the Eimco 105 sits up front where he can see his work. The controls are easy and convenient. Tractor controls require only one hand with the other free to operate the attachment. Foot pedals have been eliminated for clutching, shifting or turning. Stopping to shift for speed changes or reverse is eliminated.

The Eimco 105 gives you new, low operating and maintenance costs. You get the work capacity of the largest crawler tractor units but with the low initial investment as well as the operating economies previously confined to the smaller tractors.

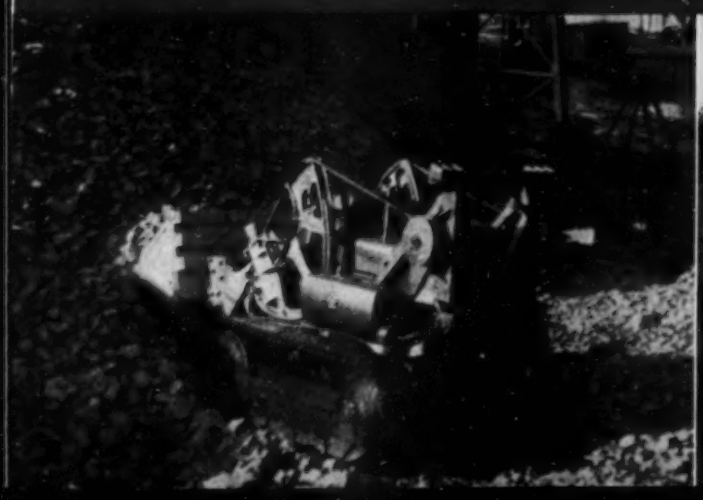
Eimco 105s offer more exclusive advantages and have improved design and construction features in EVERY part. This is the reason Eimco 105s are increasing output with lower operating and upkeep costs on every job. See this revolutionary piece of tractor equipment before you consider buying anything in the tractor, excavator, shovel or bulldozer line. Write for complete information. The Eimco Corporation, P. O. Box 300, Salt Lake City, Utah.

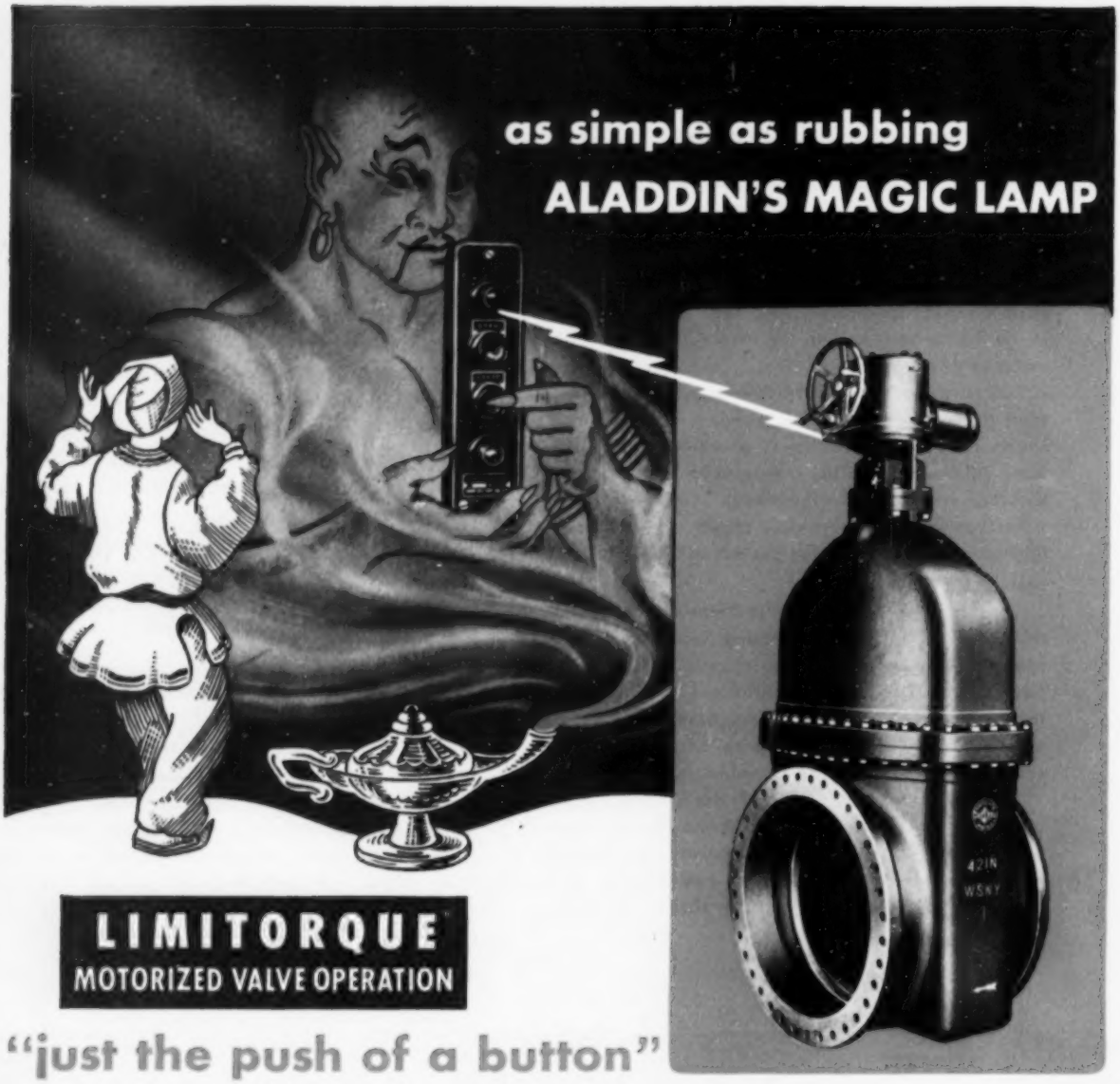
EIMCO

THE EIMCO CORPORATION

Salt Lake City, Utah, U.S.A.

Export Office: Eimco Bldg., 52 South St., New York City





LIMITORQUE
MOTORIZED VALVE OPERATION

"just the push of a button"

Hardly less magical than the rubbing of a lamp, accompanied by a few mysterious incantations—is the opening and closing of huge valves under high pressures, in remote places, or even miles away—by the MERE PUSH OF A BUTTON. Yet, that is the magic of *Limitorque* Valve Operation—safe, sure, dependable, accurate—and without the possibility of any damage to valve stem, seat, or disc.

Limitorque, is truly Valve Operation Magic—and that is why far more *Limitorque* Valve Operators are used today, than all others combined. Be convinced, send for our latest catalog.

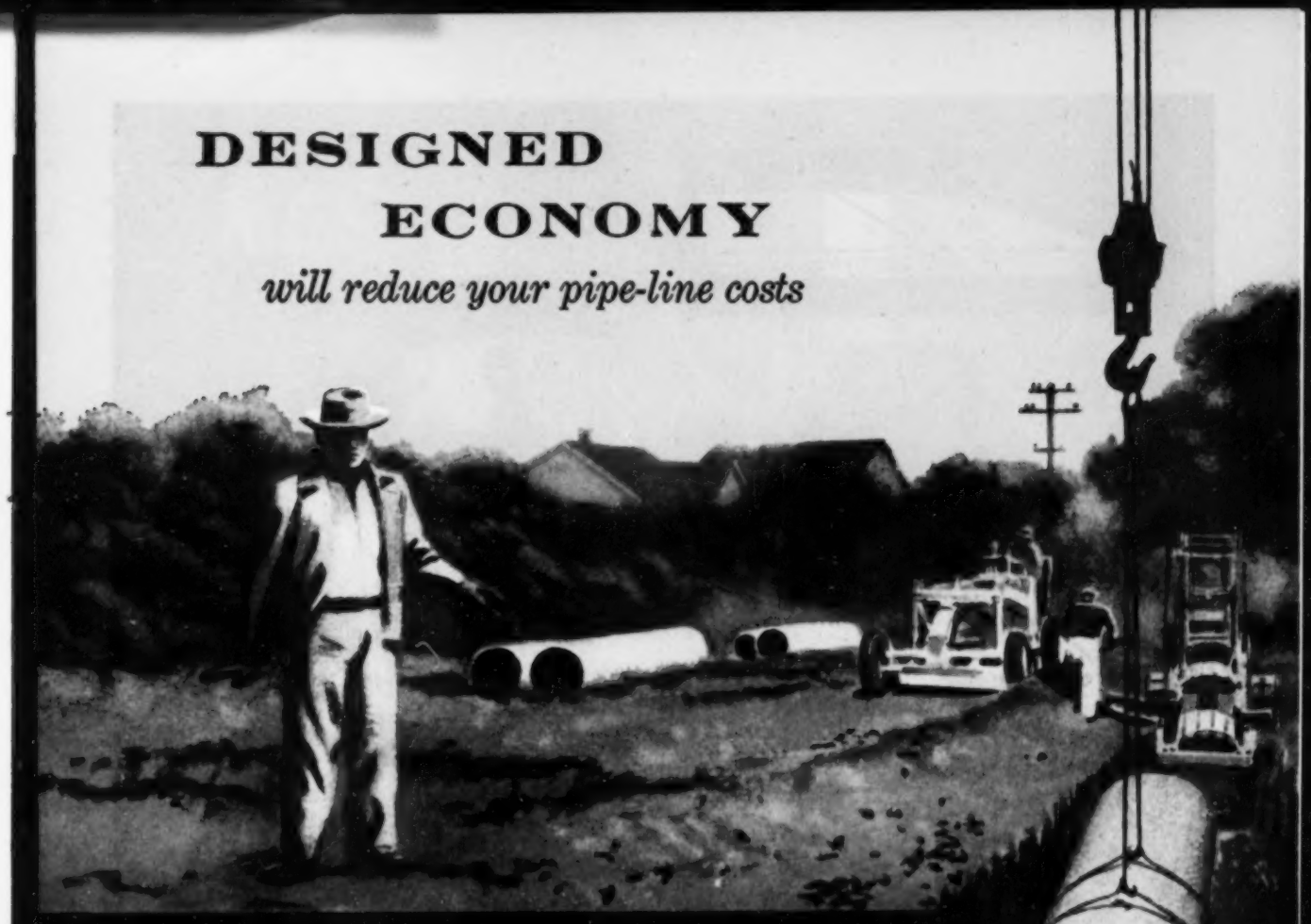
Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

DESIGNED ECONOMY

will reduce your pipe-line costs



Each of American's six classes of reinforced concrete pressure pipe is designed for the most efficient utilization of its steel components. Nearly half a century of design refinement, exhaustive testing and field experience has produced composite designs which are completely adequate for safe resistance to all internal stresses and external loading conditions.

In these designs *all* of the materials are working for you. The result is a better pipe-line per dollar of investment. In addition, quality materials and sound workmanship ensure sustained high performance and low maintenance costs in the future.

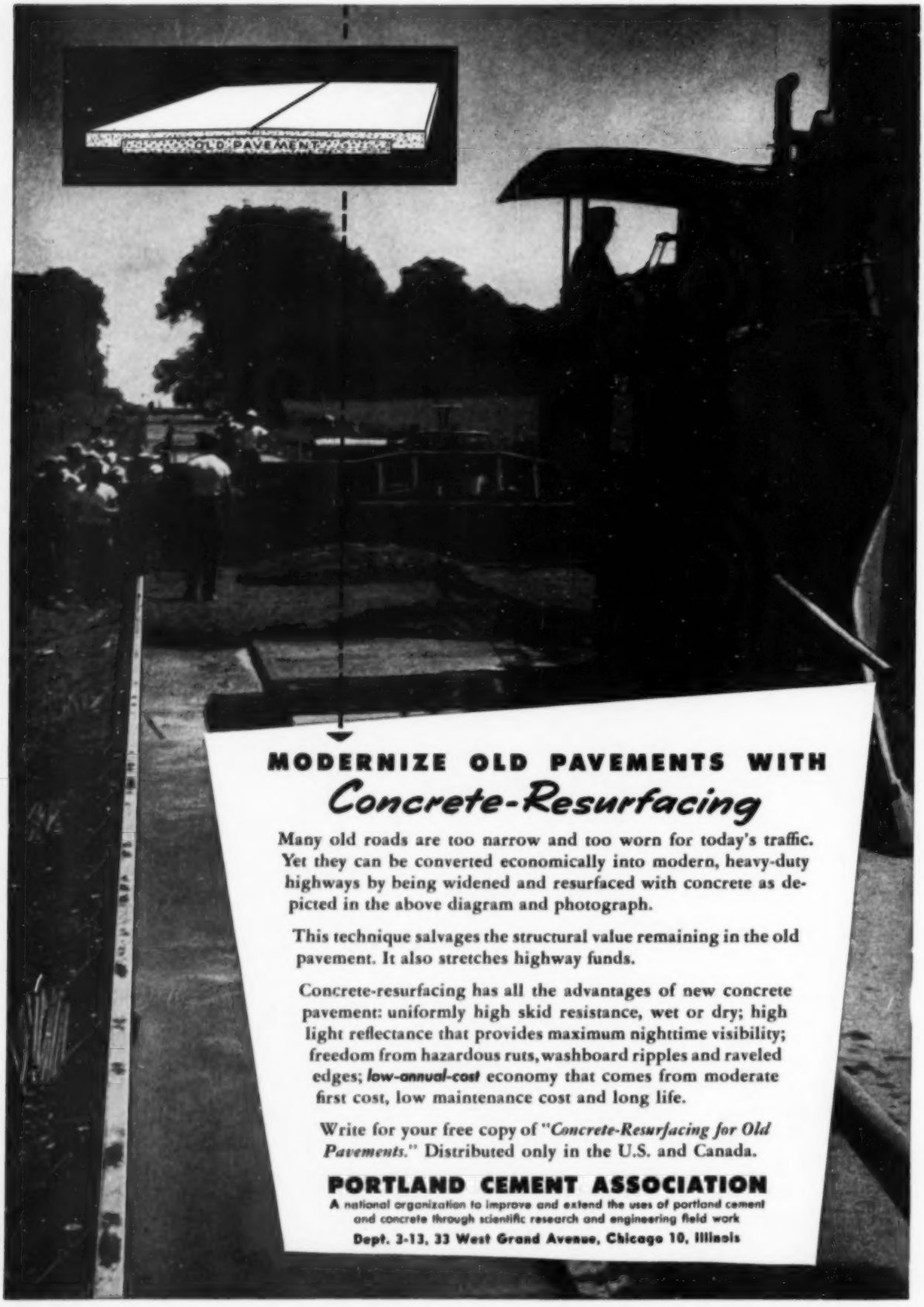
Our 45 years of specialized design and manufacturing experience in the water works field is at your service. Write or call for complete information.

American PIPE AND CONSTRUCTION CO.

P. O. Box 3428, Terminal Annex, Los Angeles 54
LOgan 8-2271

Main Offices and Plant: 4635 Firestone Blvd., South Gate, California
District Sales Offices and Plants—Oakland • San Diego • Portland, Ore.

Concrete pipe for main water supply lines, storm and sanitary sewers, subaqueous pipe lines



MODERNIZE OLD PAVEMENTS WITH

Concrete-Resurfacing

Many old roads are too narrow and too worn for today's traffic. Yet they can be converted economically into modern, heavy-duty highways by being widened and resurfaced with concrete as depicted in the above diagram and photograph.

This technique salvages the structural value remaining in the old pavement. It also stretches highway funds.

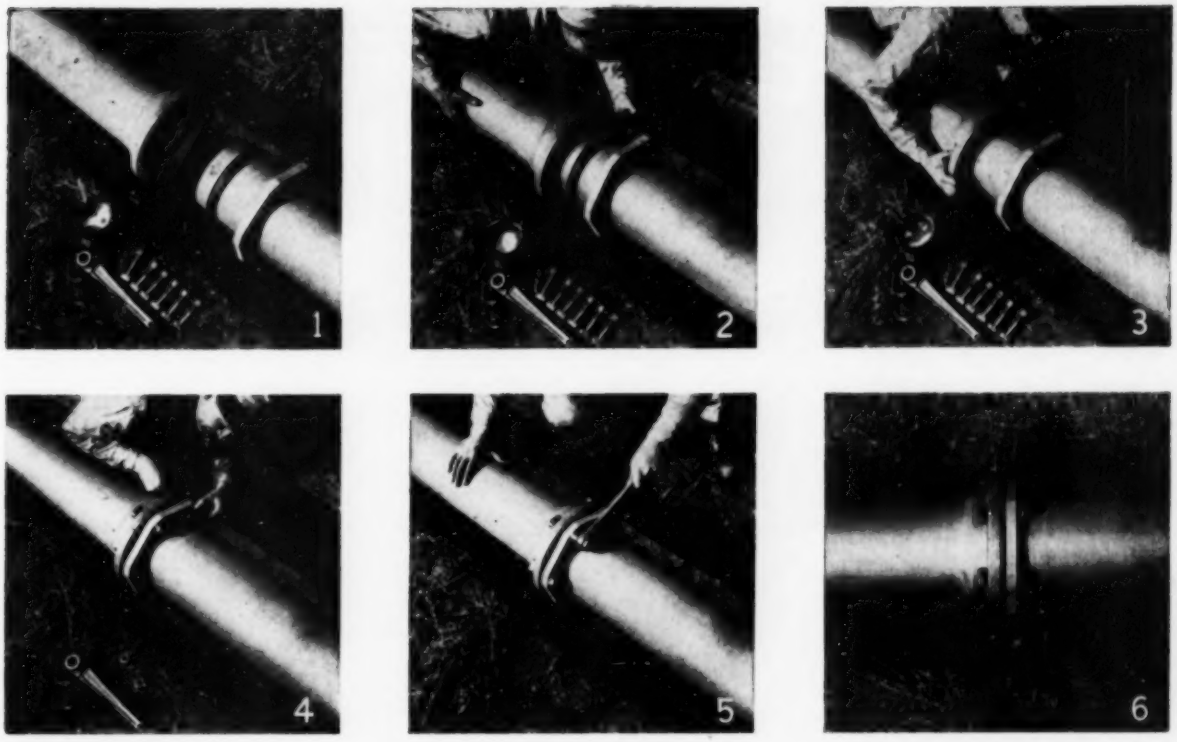
Concrete-resurfacing has all the advantages of new concrete pavement: uniformly high skid resistance, wet or dry; high light reflectance that provides maximum nighttime visibility; freedom from hazardous ruts, washboard ripples and raveled edges; ***low-annual-cost*** economy that comes from moderate first cost, low maintenance cost and long life.

Write for your free copy of "*Concrete-Resurfacing for Old Pavements.*" Distributed only in the U.S. and Canada.

PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

Dept. 3-13, 33 West Grand Avenue, Chicago 10, Illinois



AMERICAN Double-X Mechanical Joint Pipe

AMERICAN Double-X is Mono-Cast centrifugal pipe with standardized mechanical joints, furnished complete with gaskets, cast iron glands, and cast iron bolts for assembling. AMERICAN Double-X has been accepted as the standardized mechanical joint by the pressure pipe industry.

The above photographs show clearly each of the progressive steps in making up the AMERICAN Double-X joint. Easy to install and providing bottle-tight joints under low, medium and high pressures AMERICAN Double-X pipe is designed to give long and dependable service with a minimum of maintenance.

The joints are so simple and rugged that common labor can make them up in record time. In addition to a brush and a bucket of soapy water, only one tool—a ratchet wrench—is required.

Manufactured under rigid specifications in diameters 2-inch through 48-inch, the pipe is corrosion resistant, will stand the impact of heavy loads and gives complete job satisfaction. This pipe is designed for the particular service requirement and for specific laying conditions. You get the exact pipe your conditions require.

A complete line of fittings for use with AMERICAN Double-X pipe is available including transition pieces for inter-connecting with other types of joints and pipe.

Write for AMERICAN Double-X pipe booklet. A free copy will be sent on request.

AMERICAN CAST IRON PIPE COMPANY

BIRMINGHAM 2, ALABAMA

MAIL COUPON FOR FREE BOOKLET

American Cast Iron Pipe Company,
Birmingham 2, Alabama

Gentlemen: Please send me a free copy of your new illustrated booklet, *"American Double-X Mechanical Joint Pipe."*

Name.....

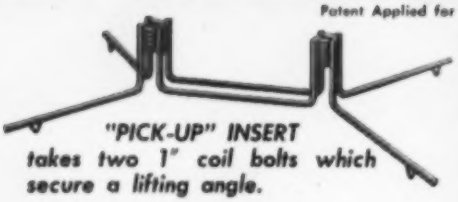
Company.....

Street.....

City.....State.....

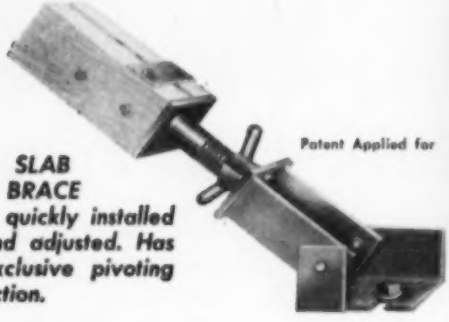
3 SUPERIOR ACCESSORIES FOR more efficient handling of "TILT-UP" SLABS

Patent Applied for



"PICK-UP" INSERT takes two 1" coil bolts which secure a lifting angle.

"ANCHOR" INSERT in both the "Tilt-Up" slab and the floor slab provides anchorage for slab brace bolts.



Patent Applied for

SLAB BRACE is quickly installed and adjusted. Has exclusive pivoting action.

Are you bidding on a "Tilt-Up Slab" job? Are you starting a "Tilt-Up Slab" Job? Then you will be interested in these SUPERIOR accessories, designed for faster and more efficient handling of precast panels.

The Superior *"Pick-Up" Insert* provides dependable anchorage for bolts which secure a lifting angle to which slings are attached when the panel is raised. *"Anchor" Inserts* in both the "Tilt-Up" slab and the floor slab secure the temporary bolts to which the braces are attached. With Superior's adjustable and pivoting *Brace* you have an efficient as well as inexpensive answer to both ordinary and unusual bracing problems . . . you merely assemble with 2 x 4's of lengths to fit individual jobs.

Wherever slabs are being "tilted-up" . . . on the Pacific Coast . . . in the Midwest . . . the South, and in the East . . . contractors are consistently using Superior Inserts, Anchors and Braces. For details request a copy of Bulletin TU-2.

SUPERIOR CONCRETE ACCESSORIES, INC.

4110 Wrightwood Avenue, Chicago 39, Illinois

New York Office
1775 Broadway, New York 19, N. Y.

Pacific Coast Plant
2100 Williams St., San Leandro, Calif.

Left: Unretouched photograph of clogged intake at the Old Badger Plant, City of Kaukauna, Wisconsin (not mechanically cleaned). Compare this with the New Badger Plant (at left).

New Plant mentioned in which intake is cleaned with a Leonard trash rack rake. Both plants draw water from the same canal.

MAINTAIN *MAXIMUM HEAD*

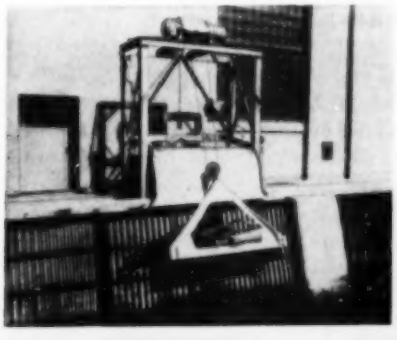
SAVE POWER LOSSES and OPERATING EXPENSES

with the

LEONARD TRASH RACK RAKE

THIS DEVICE IS USED AT INTAKES TO HYDRO-ELECTRIC PLANTS, STEAM POWER PLANTS AND PUMPING STATIONS to remove leaves, river grass, lily pads, branches, logs, pulp wood, or other extraneous matter which gather on the racks to obstruct the water supply.

LEONARD raking equipment is specified by many of the country's leading Engineers, as well as public works agencies such as the U. S. Engineers, and the Bureau of Reclamation. Write for our Bulletin 158 and list of installations.



Left: Leonard raking unit at the St. Mary's Falls Hydro-Electric plant, Michigan; a U. S. Engineers project.

Right: View of forebay and power house at the Thilmany Plant, City of Kaukauna, Wisconsin. In addition to the Leonard rakes at this plant and the New Badger plant, the City also has one at its Little Chute plant.

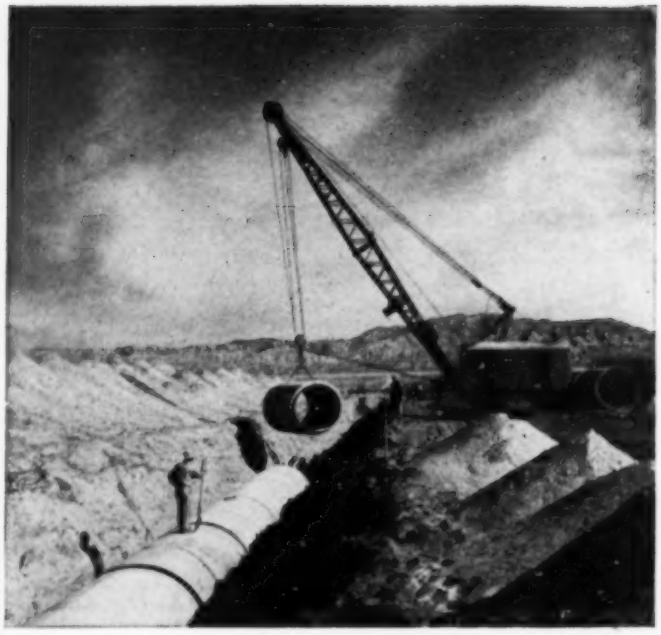
POWER by SMITH — 16,000,000 HP

76 YEARS EXPERIENCE DESIGNING AND MANUFACTURING HYDRAULIC TURBINES AND ACCESSORY POWER PLANT AND PUMPING STATION EQUIPMENT

S. MORGAN SMITH CO. York, Penna., U.S.A.

U. S. BUREAU OF RECLAMATION SPECIFIES

Concrete Pressure Pipe



When the U.S. Bureau of Reclamation builds a pipeline, it must last a long, long time.

This is why the Bureau has specified concrete pressure pipe in many projects under its jurisdiction throughout the Western States. In the State of California alone, approximately 3,000,000 feet of concrete pressure pipe have been used in diameters ranging from 12″ through 84″, and for heads up to 650 feet. These jobs include the Coachella Valley Project, the Cachuma Project near Santa Barbara, both barrels of the San Diego Aqueduct, and the Central Valley Project.

Large pipe distribution systems, often calling for heads of 200 feet and over, are jobs for concrete pressure pipe. So, when your city is planning a water transmission system with either low or high heads be sure to get the facts on concrete pressure pipe.

Member companies manufacture concrete pressure pipe in accordance with nationally recognized specifications

Concrete PRESSURE Pipe

WATER FOR GENERATIONS TO COME

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

Here's why an AUSTIN-WESTERN power grader gives you 30% more power at the blade and twice the maneuverability

Much of the time, All-Wheel Drive and All-Wheel Steer work as a team to provide CONTROLLED TRACTION. In this position, the rear drivers push behind the toe of the blade; the front drivers pull ahead of the heel of the blade, and the machine moves straight ahead with a load on its blade that would cause the ordinary grader to become unmanageable.

On the ordinary front steer, rear drive motor grader, the front end is just that much dead weight which the rear end has to push around. *Total* weight is not the measure of motor grader operating efficiency. What counts is the useful working weight carried on driving wheels; all other weight consumes power, and is a definite handicap.

On the Austin-Western Power Grader, there are no idling front wheels . . . no dead front end to consume power and decrease operating efficiency. All weight is on driving wheels—front and rear—contributing 100 percent to traction. Dynamometer tests, conducted with the greatest accuracy, have proved conclusively that with two graders of the same weight and horsepower, working in first or second gear where real earthmoving is done, an all-wheel drive machine has 30 percent more power-at-the-blade than one with rear drive only.

With its ability to steer both ends of the machine in the same direction or opposite directions, the Austin-Western Power Grader has twice the maneuverability of other graders; works around short-radius curves impossible for machines with front steer only; turns easily on narrow roads and trails, and maneuvers more closely around culverts, bridges and other obstructions.

Spring and Summer, Fall and Winter, the A-W Power Grader outperforms all other motor graders . . . on all types of work, and under all conditions.

Austin-Western

Power Graders • Motor Sweepers
Road Rollers • Hydraulic Cranes

BALDWIN BLH LIMA-HAMILTON

Construction Equipment Division

Manufactured by
AUSTIN-WESTERN COMPANY
Subsidiary of Baldwin-Lima-Hamilton Corporation
AURORA, ILLINOIS, U.S.A.

New lateral force design reference

by Harry C. Plummer, Director of Engineering & Technology
Structural Clay Products Institute

and John A. Blume, Consulting Structural Engineer
San Francisco, California

Over 150 details, tables and photographs

only $4.95

timely... authoritative... complete...

This new textbook is written to meet the growing demand among engineers and architects for concise, authoritative information about structural systems which will resist tornadoes, earthquakes or bomb blast. (A recent survey shows that lateral force considerations are playing a more important role in the design of many structures.)

The book tells how to use Reinforced Brick Masonry (RBM) in lateral force design—thereby retaining the advantages of brick's wide color range, pleasing textural effects, permanence and freedom from maintenance. It contains scores of details of RBM construction in a wide variety of structures, comparative cost figures, data on the performance of both reinforced and unreinforced masonry, recommended design and construction procedures and a review of currently accepted design criteria.

SEND COUPON TODAY

Structural Clay Products Institute, Dept. CE-3
1520 18th Street, N. W.
Washington 6, D. C.

Please send me_____copies of "Reinforced Brick Masonry and Lateral Force Design" at $4.95 per copy.
I enclose my check for $_____

Name_____

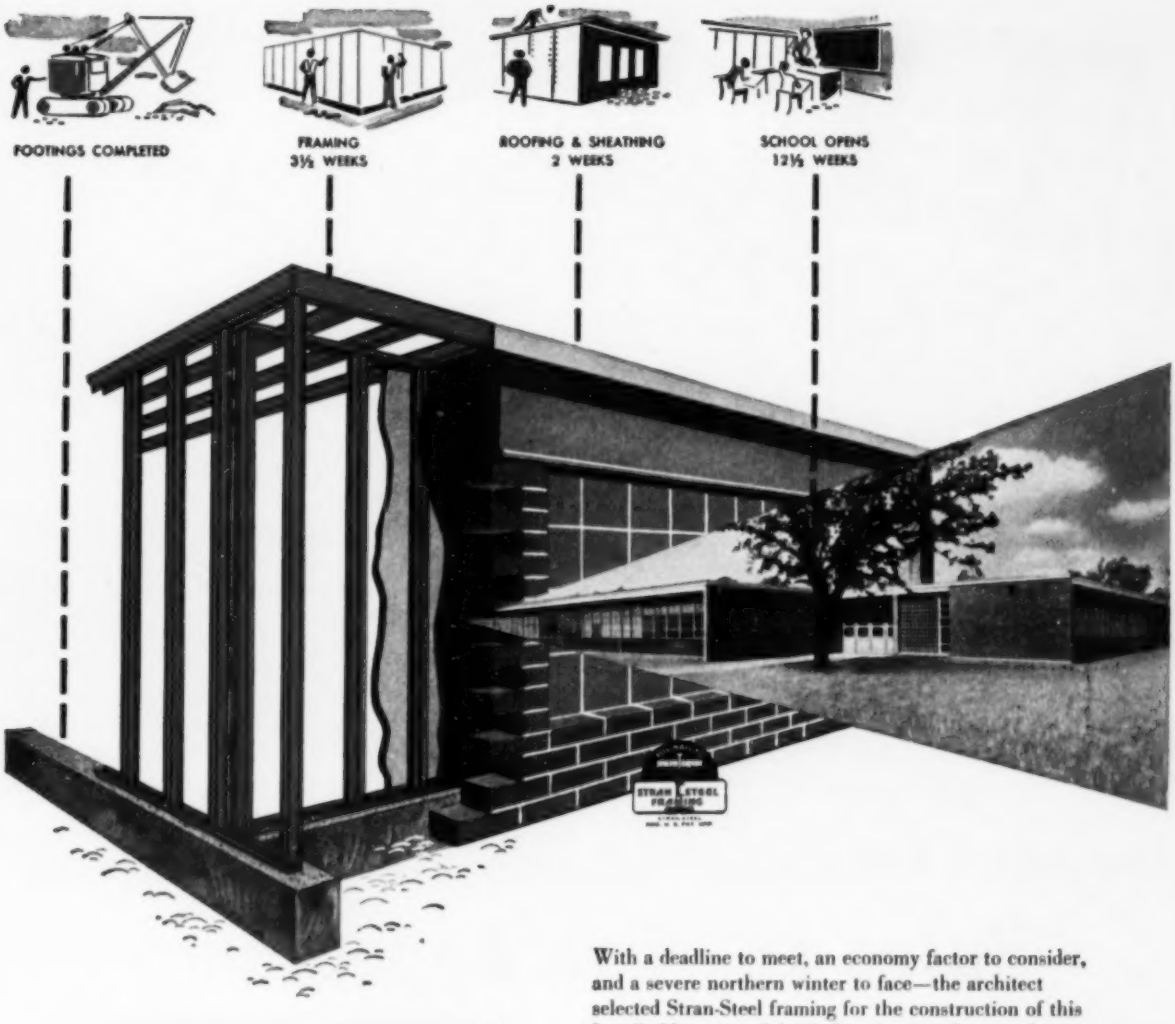
Firm_____

Address_____

City_____ Zone_____ State_____

SCPI

STRUCTURAL CLAY PRODUCTS INSTITUTE
1520 18th Street, N. W., Washington 6, D. C.



STRAN-STEEL® FRAMING

opened this school on schedule at a saving of $5,000!

With a deadline to meet, an economy factor to consider, and a severe northern winter to face—the architect selected Stran-Steel framing for the construction of this Lovell, Minnesota School, District #48. It proved a wise choice for many reasons. The architect, H. B. Crommett, St. Paul, Minnesota, could not afford to take a chance on weather stoppages. Quick erection of nailable Stran-Steel wall frames and the roof-joist system in early fall permitted him to begin immediately on closing-in. With the finished built-up roof and insulating sheathing, and windows installed, a weatherproof interior was completed to permit the building trades to start work. The brick veneer could be installed at any date when weather permitted.

Actual working time was approximately 4½ months and the cost was estimated by the architect to be $5,000 less than any other comparable material he might have used. Again, the versatility and adaptability of Stran-Steel framing helped the architect and the general contractor to do a good job, quickly and economically. Adolphson and Peterson, of St. Paul was the general contractor.

Write for this explanatory booklet.

GREAT LAKES STEEL CORPORATION
Stran-Steel Division **Ecorse, Detroit 29, Mich.**
PRODUCER OF NAX HIGH-TENSILE STEEL
NATIONAL STEEL CORPORATION

Contractor: Lundy Construction Company, Williamsport, Pa. Engineers: A. W. Lookup Company, Philadelphia, Pa. Architect: D. H. Grootenboer, Williamsport, Pa.

Economical Architectural Concrete made with Duraplastic*

Rates an "A" in Appearance

THE NEW Theodore Roosevelt Junior High School in Williamsport, Pa., scores high in appearance as well as economics — construction costs are held down because architectural concrete serves as both structural *and* facing material. And lowest possible maintenance and insurance costs can be figured with durable, fire-safe concrete construction. For better concrete quality, Atlas Duraplastic air-entraining portland cement was used throughout.

Duraplastic aids proper placement with improved surface appearance because of its more workable, more plastic mix. It requires less mixing water for a given slump. And with Duraplastic, there's another big advantage—

The air-entraining feature, originated and developed by Universal Atlas, minimizes bleeding or water gain and segregation. Thus the finished concrete is fortified against the effects of freezing-thawing weather.

YET DURAPLASTIC COSTS NO MORE. These advantages are yours simply by *specifying* Atlas Duraplastic. It sells at the same price as regular cement and requires no unusual changes in procedure. Complies with ASTM and Federal Specifications. For more information, write Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Ave., New York 17, N. Y.

OFFICES: *Albany, Birmingham, Boston, Chicago, Dayton, Kansas City, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis, Waco.*

*"Duraplastic" is the registered trade mark of the air-entraining portland cement manufactured by Universal Atlas Cement Company.

ATLAS® **DURAPLASTIC**

AIR-ENTRAINING PORTLAND CEMENT

A UNIVERSAL ATLAS PRODUCT

CE-D-150

Makes Better Concrete at No Extra Cost

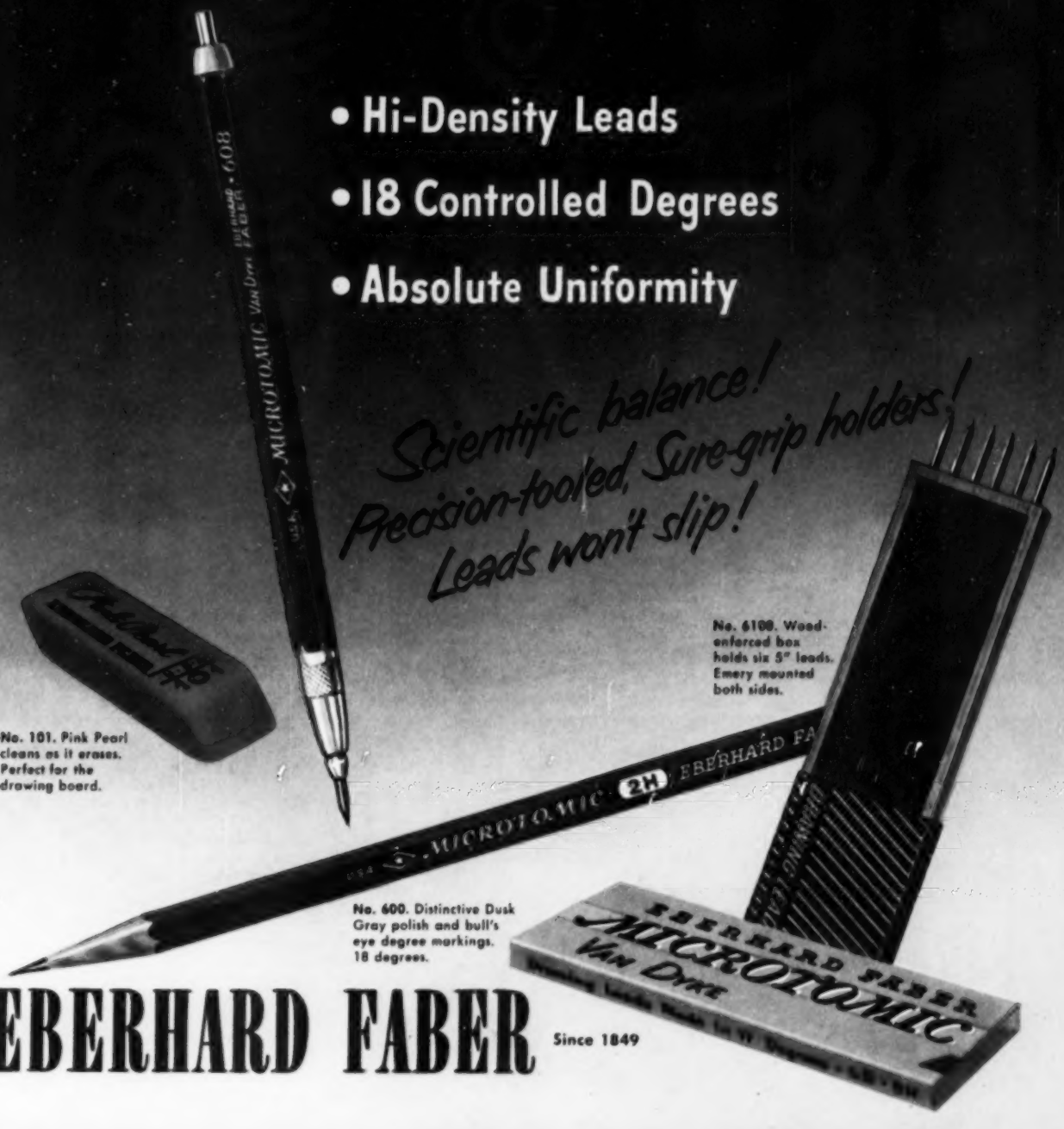
UNITED STATES STEEL HOUR—Televised alternate weeks—See your newspaper for time and station.

AUTOMATICALLY THE CHOICE OF THE PROFESSIONALS

MICROTOMIC

- Hi-Density Leads
- 18 Controlled Degrees
- Absolute Uniformity

Scientific balance! Precision-tooled, Sure-grip holders! Leads won't slip!



No. 101. Pink Pearl cleans as it erases. Perfect for the drawing board.

No. 600. Distinctive Dusk Gray polish and bull's eye degree markings. 18 degrees.

No. 6100. Wood-enforced box holds six 5" leads. Emery mounted both sides.

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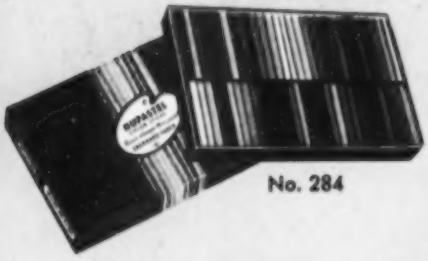

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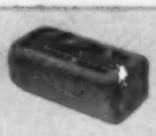

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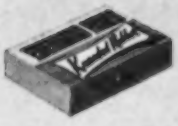

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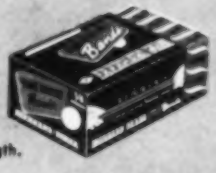

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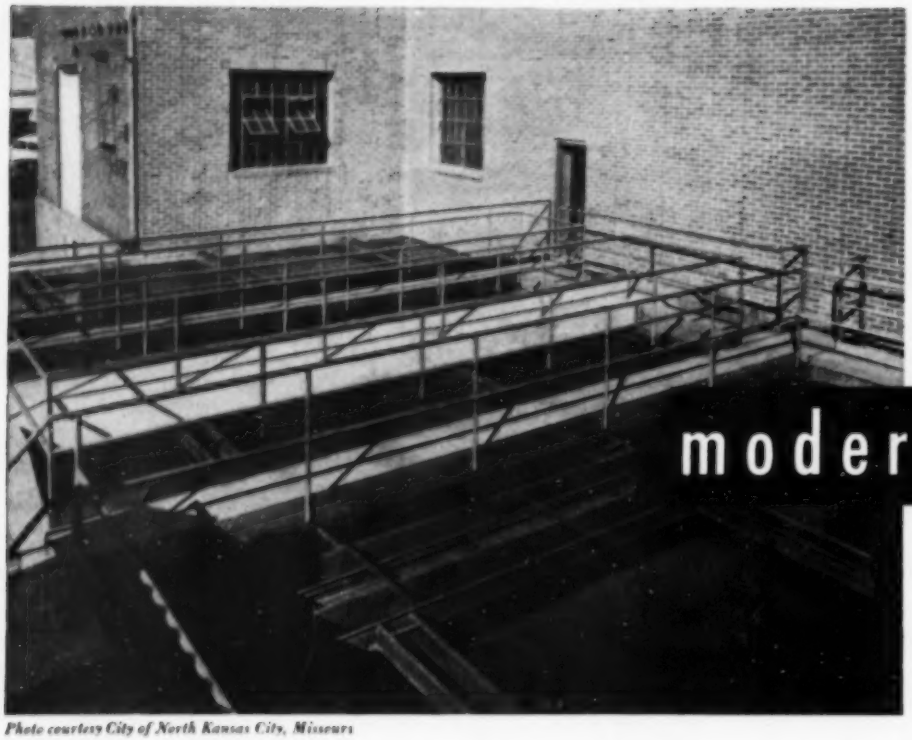

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Photo courtesy City of North Kansas City, Missouri

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Water Analysis Report Before and After Conditioning

			PPM as	Raw Water from wells before aeration	Precipitator effluent (unfiltered)
CATIONS	Calcium	(Ca++)	$CaCO_3$	145	55
	Magnesium	(Mg++)	$CaCO_3$	103	75
	Sodium	(Na+)	$CaCO_3$	108	105
ANIONS (Alkalinity)	Bicarbonate	(HCO_3−)	$CaCO_3$	190	42
	Carbonate	(CO_3−−)	$CaCO_3$	0	24
	Hydroxide	(OH−)	$CaCO_3$	0	0
ANIONS	Chloride	(Cl−)	$CaCO_3$	35	35
	Sulfate	(SO_4−−)	$CaCO_3$	146	139
Total Hardness			$CaCO_3$	248	130
Alkalinity A (Methyl Orange)			$CaCO_3$	190	66
Alkalinity B (Phenolphthalein)			$CaCO_3$	0	12
Free Carbon Dioxide			CO_2	16	0
IRON (total)			Fe	5.0	0.1
Silica			SiO_2	16.8	13.0
MANGANESE			Mn	0.2	0.0
TURBIDITY (after shaking)				50	3
Fluorides			F	0.5	0.4
Color				Turbid	5
pH				7.3	9.5
Total Hardness (as $CaCO_3$)			Result in grains per U.S. Gal.	15	7.6

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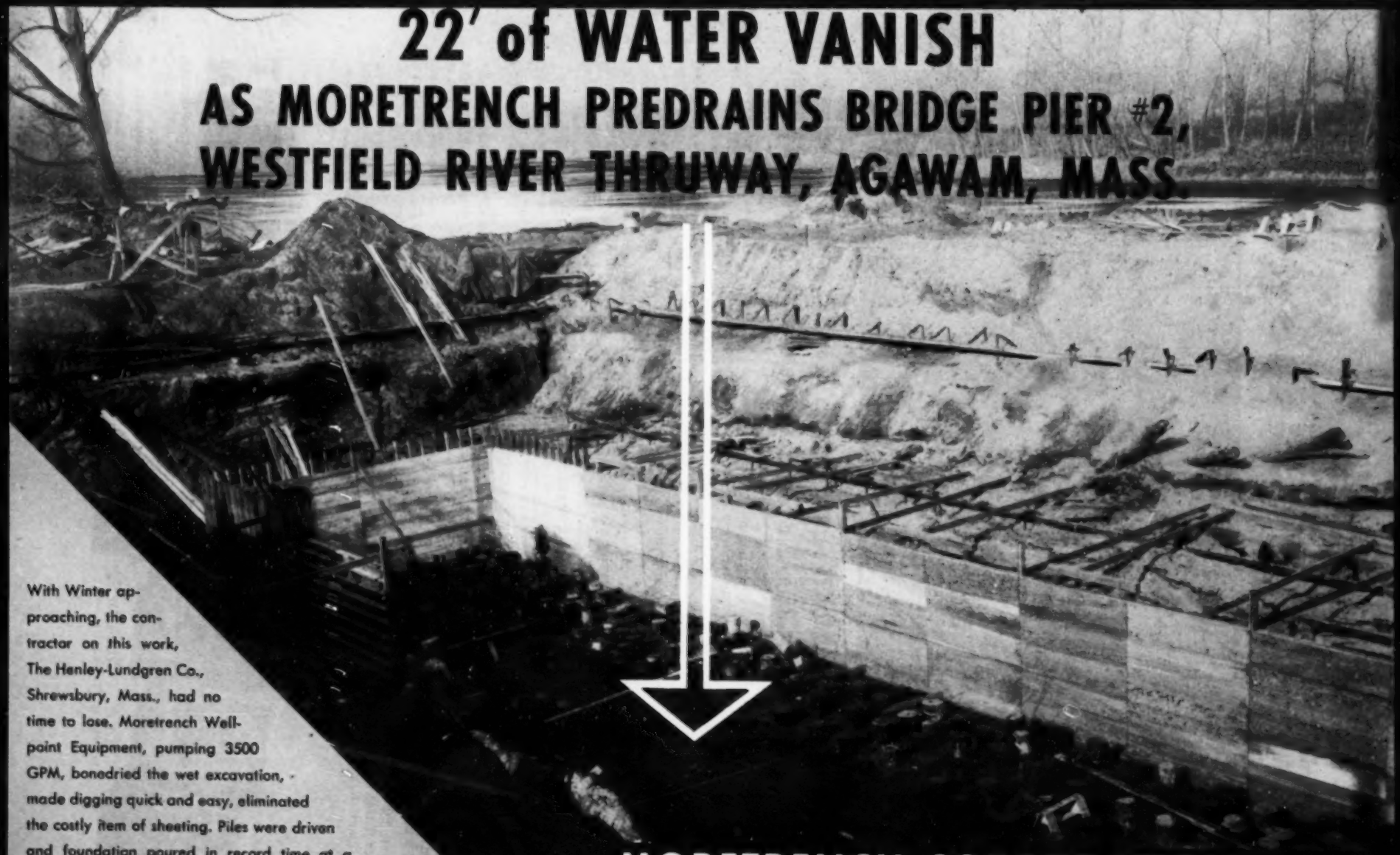

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Mix	Water	Drying Shrinkage—inches per 100 ft.				
bags/cu. yd.	gal./bag	3 d	7 d	28 d	3 mo.	1 yr.
Average 19 Lone Star Type I Cements (6-inch slump)						
3½	10.59	.156	.264	.516	.612	.648
4¼	8.27	.156	.24	.516	.624	.684
5	6.78	.18	.252	.528	.66	.696
6	5.62	.168	.228	.48	.636	.684
7½	4.65	.156	.228	.468	.636	.696
Average 10 'Incor' Type III Cements (6-inch slump)						
3½	10.48	.156	.252	.516	.648	.672
4¼	8.29	.156	.216	.48	.636	.672
5	6.9	.144	.216	.468	.636	.672
6	5.83	.156	.228	.444	.636	.684
7½	4.93	.156	.24	.48	.648	.708

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CIVIL ENGINEERING

MARCH 1954

THE MAGAZINE OF ENGINEERED CONSTRUCTION

• CONTENTS • VOLUME 24 • NUMBER 3

M. E. Cox	41	**ATLANTA BUILDS FREEWAY—A plan emerges**
L. H. Lyle, R. C. Tate	44	**Location refined and designs made**
B. P. McWhorter	47	**Construction problems concerned with public relations**
George Wrigley, Jr.	50	**Standard proposed for precision of construction cost estimates**
Fred N. Severud	52	**Materials combined to advantage in Livestock Pavilion**
N. L. Liver, E. C. Mardorf, J. C. King	56	**Mixed-in-place piles form jetty to control beach erosion**
W. A. Giddings	58	**A contractor reviews his headaches at Clark Hill Powerhouse**
Fred B. Farrell	61	**Small delays—a big problem on highway construction jobs**
Carl E. Bentzel	64	**BUFORD DAM—Engineer Corps builds multi-purpose structure**
Chas. A. Jackson Jr.	67	**Features of construction interest**
Serge Leliavsky	70	**Sloping-sill sand screens for Egyptian irrigation canals**
I-T'an Yu	72	**Nomographs for rapid design of bearing plates**

• SOCIETY NEWS

	74	**Ballot on dues increase authorized at Atlanta Convention**
	76	**Atlanta Actions of Board of Direction briefed**
	77	**Board opposes competitive bidding**
	77	**Board acts on engineer bidding in South Carolina**
Joseph H. Ehlers	80	**From the Nation's Capital**
	82	**Notes from the Local Sections**

• NEWS BRIEFS

89	**Toronto subway is ready for passengers**
89	**First atomic-powered submarine launched**
90	**$750,000 traffic study to be made in New York area**
91	**January construction expenditures at record high for the month**
92	**Prestressed concrete experts confer in Toronto**

• DEPARTMENTS

60	How Would You Do It?	115	Recent Books
70	Field Hints	116	New Publications
72	Engineers' Notebook	117	Non-ASCE Meetings
73	The Readers Write	118	Positions Announced
85	ASCE Scheduled Meetings	118	Applications for Admission
96	N. G. Neare's Column	122	Equipment, Materials and Methods
98	Deceased		
106	News of Engineers	129	Literature Available
114	Men and Jobs Available	136	Index to Advertisers
131	**Proceedings Papers Available as Separates**		

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CIVIL ENGINEERING
MARCH 1954
THE MAGAZINE OF ENGINEERED CONSTRUCTION

FIG. 1. Gray bands indicate Atlanta's traffic density in 1970, as estimated from comprehensive surveys made during 1941–1945. Freeway system now under construction generally follows these bands.

Atlanta builds freeway to relieve congestion

Metropolitan Atlanta realized as early as 1940 that something had to be done to relieve traffic congestion or the city would suffer the serious consequences of strangulation. The few through streets added their choking effect to an already critical situation. Full analysis of data collected during 1941–1945 from surveys of auto and truck traffic, parking habits, and driver interviews resulted in the adoption of the Atlanta highway and transportation plan now under construction. Funds from bond issues voted by the citizens of Atlanta and Fulton County were matched by funds from the State of Georgia and from the U.S. Bureau of Public Roads. This 56-million-dollar north and south freeway is a divided expressway system providing for four, six, and eight lanes of traffic as needed, for a distance of about 20 miles. It compares favorably with similar facilities in other parts of the country. Its planning, financing, design, and construction are described in the following three articles. Those by Mr. Cox and Mr. McWhorter were prepared from their papers presented respectively before City Planning and Construction Division sessions at the Atlanta Convention.

A highway and transportation plan emerges

M. E. COX, M. ASCE

General Chairman, Joint Bond Commission, Fulton County and City, Atlanta, Ga.

The first survey information for the relief of Atlanta's traffic congestion was collected in 1941 by establishing a cordon around the central business area and setting up 44 stations along it at which interviews were held with as many drivers as could safely be stopped. This survey was made by the State Highway Department and the U. S. Bureau of Public Roads. In 1944 these same organizations made a more extensive survey in response to similar resolutions by the Mayor and General Council of the City, and the Commissioners of Fulton County.

The decision to make the 1944 survey was reached after many conferences and discussions among technical coordinators from the Washington office of the Bureau of Public Roads, local officials, and Highway Department representatives. It was to be a comprehensive, area-wide traffic

survey of Metropolitan Atlanta and its environs to obtain complete data on a representative sample of trips made by residents in a normal day.

The survey was divided into four parts. (1) internal or house-to-house interviewing at residential units within a prescribed area to obtain information on the origin of trips, their destination and purpose; (2) external or vehicular interviewing of drivers entering or leaving the prescribed area to obtain similar trip information; (3) a parking survey to obtain origins and destinations of trips and parking habits, such as duration of parking, cost, and distance walked after parking; and (4) a truck survey to provide needed information on truck company operations, their organizations, and their use of roads and streets, so that an accurate estimate of the future needs of the trucking industry could be made, including the feasibility of a union truck terminal and whether such a terminal would be self-liquidating in a reasonable time.

After a period of preparation, including selection of a representative sample of the population to be interviewed, the internal survey was started December 3, 1944. The 5-percent sample was selected in accordance with principles followed by the U. S. Census Bureau and other fact-gathering organizations, to provide a true picture of the daily trips taken in each of the area's many different population groups.

The external survey, which was conducted simultaneously with the internal survey, was made by interviewing as large a sample of drivers of all vehicles crossing the 1941 external cordon line (at the same 44 stations used in 1941) as safe traffic-control practices would permit.

On May 11, 1945, with the cooperation and help of the Atlanta Council, Boy Scouts of America, the Atlanta Police Department, and a number of other civic and governmental groups, a parking study within the limits of the central business district was conducted. This study was to determine the parking habits, sites of concentration of parking, turnover, accumulation, supply and demand, and other characteristics of vehicular parking within the area.

As these surveys were completed, the data were coded and tabulations were produced, from which the analyses of the various phases were made. The traffic density for 1970, estimated from these data, is shown in Fig. 1.

In the meantime, on December 14, 1944, a contract was entered into between the State Highway Department and the consulting engineering firms of H. W. Locher and Company, and DeLeuw, Cather and Company of Chicago. The contract provided for an analysis of the data already collected, the collection of such additional data or information as required, the preparation of layouts, designs and estimates for—and the recommendation of—a system of roads, streets and/or expressways to serve the metropolitan area north, east, south, and west of the central business district of Atlanta. The consultants immediately started work. Late in 1945, a great mass of factual data, collected by the Highway Department from trucking companies operating into, out of, and through Atlanta, was also turned over to the consultants.

On January 10, 1946, the consultants submitted their "Highway and Transportation Plan" for Atlanta, which embodied their reports, recommendations, estimates and drawings. This plan, Fig. 2, called for a "freeway" system of four sections—north, south, east and west—to be serviced by a connector link near the center of the business district. The freeway was to be depressed and its outer legs were to be four-lane, separated by a 23-ft median strip. The downtown connector was to be two 36-ft lanes separated by the 23-ft median strip. This plan has been the basis for further study, field surveys, and location of the expressways as well as a large number of individual betterment projects at bottlenecks, street jogs, and other locations requiring remedial treatment.

The cost of all these surveys, analyses, studies, and reports was borne by the State of Georgia and the U. S. Bureau of Public Roads.

After a period of public presenta-

FIG. 2. Freeway system for Atlanta, as adopted in principle in 1946 by Georgia Highway Department, formed basis for federal-aid financing. System as finally adopted is shown in Fig. 3, page 44.

tions of the recommendations in the "Highway and Transportation Plan," not only to the governmental authorities involved, but to civic and other groups, the plan was given tentative approval which led to the next stage of planning—that dealing with financing.

Financed by local and federal funds

In 1944, Congress authorized funds for urban work but these funds had to be matched. The State Highway Department had funds that could be programmed for the beginning of design and construction, but the funds available were so limited that no real start could be made on such a large and expensive undertaking. The city and county did not have surplus funds in their budgets with which to supplement the federal and state funds; therefore they have each raised two bond issues. The first issues, in 1946, were for $20,200,000 each, and the others, in 1952, were for $6,350,000 each.

Out of the 1946 bond issues, $16,600,000 was allocated to the Freeway system and necessary connections for traffic relief in Atlanta, and all the 1952 bond issues were allocated for the same purpose. Out of this total of $29,300,000, $10,291,500 has been obligated or spent on Freeway construction, and an additional $9,500,000 has been allocated. In addition to this money, a total of $11,900,000 of matching state and federal funds have been obligated or spent on the Freeway.

Work remaining to be financed, about 3 miles between Spring Street and University Avenue, through the heart of Atlanta, and the remainder of the northwest leg, will approach another $25,000,000 for rights-of-way and construction.

The control of the expenditure of these bond funds in developing the Atlantic Freeway is unique. The Board of County Commissioners of Fulton County and the General Council of the City of Atlanta each passed resolutions authorizing the appointment of a Joint Bond Commission to which each corporate body appointed five members. The members selected were outstanding businessmen in the area, free of any political connections or obligations. The same resolutions authorizing the formation of the commission also specified that no bond funds would be spent unless the expenditure was approved by the Joint Bond Commission. It has proved to be a workable solution for handling the Freeway operations.

Although a well prepared plan was available, there still remained the job of fitting it in detail into existing conditions to provide an acceptable and workable program. This planning job is still going on.

Plans of local governmental units for developing several large industrial sites caused changes to be made in the locations of the northeast and south legs of the expressway. Revised figures on the costs of right-of-way and of adjusting utility lines such as sewers, electric, gas and communication systems, caused changes to be made in grades and location. On the section known as the "downtown connector" a relocation was adopted to avoid the costly and difficult reconstruction of a large trunk sewer. For these reasons the depressed section recommended in the original plan has been changed in some locations to grade level or even elevated construction.

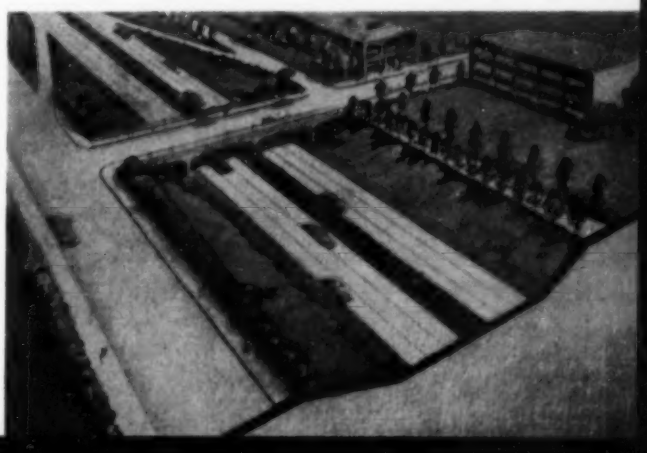
On the whole, it is confidently believed that these changes have brought no adverse effects, and in most instances have resulted in greater usefulness, making the expressway fit better into the overall plan of the city, and coordinating it with industrial developments, parking facilities, and public transit operations.

The process of planning a system of expressways such as that in Atlanta never ends so long as any part of it remains unfinished, and perhaps even then there will be additions and connections to be planned. The original plans proposed a system of four-lane divided highways with a six-lane section approximately one mile long in the center of the city. The unprecedented mushrooming of vehicular traffic that took place after World War II forced a change in the plan to provide for 4 miles of six-lane divided roadway and a downtown stretch of 8 lanes extending for a distance of one mile.

Our experience indicates that it is necessary to have a complete plan prepared for such an expressway system before any construction is undertaken, but this plan must be used as a preliminary plan, to be adjusted to new conditions as they develop. When the expressway construction period extends over a number of years, changes occur in industrial, commercial, and residential developments which, even under good zoning and control ordinances, require careful adjustment of the expressway. A rigid transportation plan for Atlanta could act like a straight-jacket in preventing needed expansion and development of whole segments of the city.

Some of the chief factors believed to be responsible for the successful development of the Atlanta Freeway system thus far are the following:

1. The complete and exhaustive study which was made of the needs and desires of motor-vehicle operators, truck and transit vehicles, including the origins, destinations, and parking requirements of all three types of vehicles.
2. Careful analysis of the results of these studies, to indicate possible expressway routes to serve major needs, with recommendations on design and location for a complete system of routes.
3. Full cooperation among all the agencies involved and a well-informed press and public. These factors were well handled by the Atlanta Joint Bond Commission. When the people want and need highway and street facilities, the frank presentation of a good plan generally will draw the necessary support and financing arrangements.
4. The development of a fresh, local-minded viewpoint to carry out the proposed plan so that it would conform to local needs and become in truth a local project on which all agencies, both public and private, could agree.
5. Keeping the planning on a flexible basis so that changes could be made as required.
6. Finally, the cultivation of a sense of humor and a thick skin.



Typical six-lane depressed Freeway section provides for frequent cross streets to be carried over expressway and for sloping ramps to collect and discharge traffic.

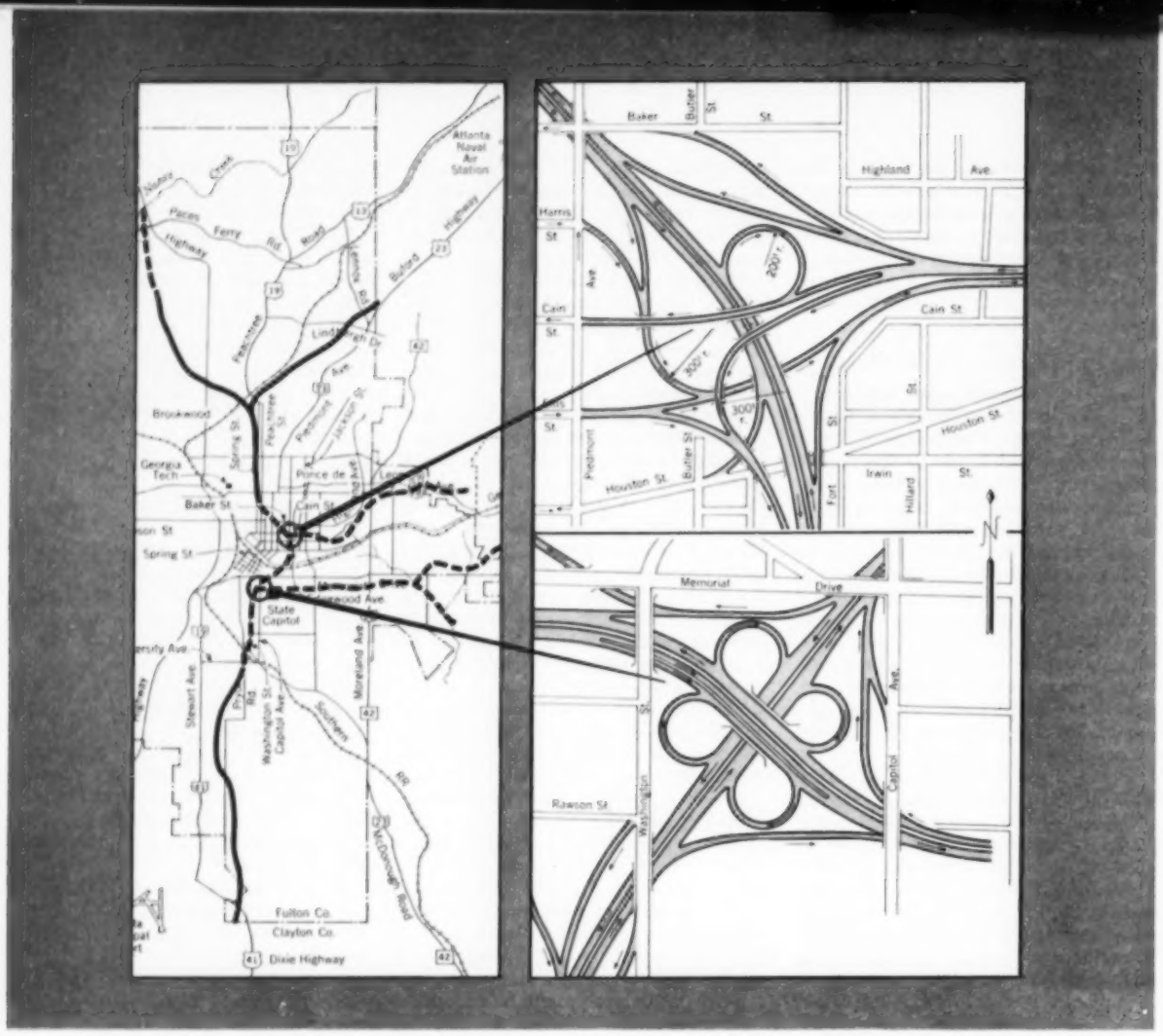


FIG. 3. Freeway system for Atlanta, as completed (solid lines), under contract or proposed for early construction (dashed lines), has length of $20^{1}/_{2}$ miles. It is also planned in future to build westerly extension to lower easterly arm at edge of central business district.

ATLANTA FREEWAY

Location refined and designs made

L. H. LYLE, M. ASCE, and R. C. TATE, Senior Roadway Designers, State Highway Department, Atlanta, Ga.

In arriving at the final location of the Atlanta Freeway, much detailed study and discussion were needed because property acquisition through a city the size of Atlanta rapidly runs into staggering amounts of money. Traffic rerouting during construction also had to be considered, as well as rerouting of utilities such as light, water and sewage so that these services would be interrupted for the shortest periods possible. Moreover, much consideration had to be given to the location of intersections, interchanges, access streets, and on and off ramps, including the future location of an east-west freeway, should that addition ever enter into the picture. The final location, shown in Fig. 3, was the result of all these studies.

In determining the grades for this project, an attempt was made to eliminate the appearance of a roller-coaster, and outside of the downtown area the vertical crests are spaced no closer than 2,000 ft. Of

Above left: Southern Railroad tracks are carried over Freeway on "Y" bridges near Monroe Drive. View looking east shows bridge carrying railroad, which consists of four simple steel beams, concrete bents, concrete floor, and steel-pipe hand rails. **Above right:** Peachtree Street Bridge over Freeway, at Brookwood Station, has two-span continuous steel beams, concrete bents and floor.

course in the downtown area the grades were controlled by existing conditions.

A design speed of 50 mph was used for the downtown area and 60 mph for outlying areas. In general, all vertical and horizontal curves have been designed to provide at least the minimum sight distance recommended by the AASHO, using 4.5 ft as height of eye and 4 in. as the height of the object seen. All vertical and horizontal clearances at bridges and underpasses also conform to AASHO specifications and recommendations.

In the downtown and intermediate areas, the maximum grade used on the Freeway is 6.13 percent. On ramps, the maximum ascending grade is 6.00 percent, and the maximum descending, 7.5 percent. In these same areas the sharpest horizontal curve used is 9 deg with 0.10 ft per ft as the rate of superelevation. In outlying areas the maximum grade used is 5.00 percent, with an ascending grade of 6.8 percent and a descending grade of 7.4 percent on ramps. The sharpest curve used in outlying areas is 3°30′, with 0.08 ft per ft as the rate of superelevation. All horizontal curves of 2 deg and sharper have spiral transitions at each end.

Soil surveys were made to locate all unsatisfactory material, which was removed and replaced with selected material. The subgrade was stabilized to a minimum depth of 6 in. and compacted to 95-percent density before paving operations began.

Where city streets cross over the Freeway, on and off ramps generally assume a diamond design (Fig. 3). One exception is a major interchange near Rawson Street which generally follows a cloverleaf pattern. Another is in the vicinity of Cain and Butler Streets, which assumes no typical design but is a crossing with direct connections to adjacent streets with multiple bridges, all traffic being free flowing to the right.

Ramps are generally 20 ft wide from curb to curb, or there are two 2-ft gutters and 16 ft of paving. Both concrete and asphalt are used for ramps. The noses of all on-ramps are pulled in to form a width of 16 ft at the entrance to the Freeway so as to force vehicles into one line. Entrance and exit ramps are designed for vehicles to enter or leave at a speed of 35 mph.

All frontage roads have a minimum width of 30 ft and are paved with either asphalt or concrete.

Drainage structures carefully designed

Great care was taken in designing the drainage system and in running out the various drainage areas. In outlying areas, where no curb or gutter was used, the drainage is all based on Talbot's formula, $a = C\sqrt[4]{A^3}$, with coefficients of 0.8 to 1.0 for mountain land, 0.6 to 0.8 for hilly terrain, 0.4 to 0.5 for rolling terrain, and 0.2 to 0.3 for flat land. This gave the size of opening required for the number of acres to be drained.

Where curb and gutter are used in the downtown area, the Rational Formula of $Q = AIR$ was used as the basis of drainage design, in which:

Q = discharge in cfs
A = area in acres (of drainage area)
I = intensity of rate of rainfall in in. per hour
R = runoff coefficient, expressed as percentage of total rainfall which enters drainage system

In this design, since the boundaries of individual drainage areas are not fixed by natural or topographic features, but by the location and spacing of inlets, A is the variable factor to be computed after the other factors have been determined. So by transposition the formula becomes, $A = Q/(IR)$.

An average value of R of 0.9 may be assumed for practically impervious paved surfaces and a value of 0.6 for sod surfaces on steep slopes of up to 3:1. Since the total areas of paved surfaces and sod surfaces on the Freeway are roughly equal, an average value of R of 0.75 was assumed for all areas.

The intensity of rainfall, I, was determined from "Plate No. 7, Intensity of Rainfall in Atlanta and Vicinity," compiled from U. S. Weather Bureau records 1878-1929 by Whitman, Requardt & Smith and Robert & Company, Inc., September 1930. This gives an intensity, or rate of rainfall, of 2.25 in. per hour for a duration of one hour. This figure, the basis of the drainage

Freeway passes over Clear Creek just northeast of Peachtree Street on bridge of three-span continuous concrete beams with concrete bents and floor.

Bridges on Atlanta Freeway were not standardized but were designed individually for best esthetic and functional results. This structure, carrying Monroe Drive under Freeway at interchange, is reinforced-concrete rigid frame designed by State Highway Bridge Department.

design, has been exceeded three times in 52 years, or an average frequency of once in 17 years, which agrees closely with the design frequency recommended by most authorities for important thoroughfares.

To determine Q, curves were plotted, one curve showing the intake capacity of one inlet on various grades up to 7 percent, overlaid by another curve showing the carrying capacity of our typical gutter flowing 3 in. deep on the same grades, both in cubic feet per second. These curves are based on actual full-scale experiments conducted by the North Carolina State College Engineering Experiment Station at Raleigh, N. C., as quoted in its Bulletin No. 30.

Then to determine the allowable Q at any inlet, for any grade, that curve was used which gave the least capacity.

For any drainage area, the maximum discharge at the inlet will occur when all parts of the area are contributing equally to the flow. Therefore if the time of concentration, or time required for water from the most remote point in the area to reach the inlet, is used as the time ordinate on the intensity curve, Plate 7, the maximum design intensity for any area can be taken from the curve. Calculations on velocities of sheet flow indicated that the time of concentration for the average areas on the Freeway would be between 3 and 4 minutes. However, since this would give extremely high intensities, it was decided to adopt a flat time of concentration (and corresponding intensity), of 10 min for all areas, and allow the inlets and gutters to be overloaded for 5 to 7 min after the peak of a storm equivalent to the design curve.

Having determined Q, I and R, as explained above, for inlets of the various grades on the Freeway, these were substituted in the formula, $A = Q/(IR)$, to solve for A, the allowable area tributory to each inlet. On the finished contour plan of the project, these areas were then determined by planimeter, which automatically fixed the location and spacing of inlets. Even where the grade is the same, the spacing varies because of the varying widths of the areas to be drained on different parts of the Freeway.

After the inlets were located, the pipelines were laid out with regard to the topography and available points of discharge.

The first section of pipe from an inlet at the upstream end of a line was given the proper size to handle the Q at the 10-min rate previously determined for its drainage area. At the next inlet down the line, the time of flow in the pipe down to this point was added to the time of concentration, and a new rate of intensity for this cumulative time was taken from the intensity curve, Plate 7.

This rate was then applied to the cumulative total of areas upstream from this point, to determine the required capacity of the next pipe downstream. In other words at each inlet in the system, the cumulative total of all the sub-areas upstream becomes A in the formula, $Q = AIR$. The cumulative total time of concentration from the furthermost point in the total area over the surface and through the pipes, determines the new value of I at the point under consideration, and R remains at 0.75. Solving for Q gives the required capacity of the next pipe downstream. This process is repeated on down each line. Where two branch lines join, the accumulated areas are added, but the largest value of accumulated time is used.

After the required capacities of the various lines have been determined, the pipe size is computed by Manning's formula, using a value of $N = 0.012$, and the grades shown on the sewer profiles. Since it is not desirable for sewers to operate under a head, pipe sizes and capacities are computed for critical velocity and critical flow, wherever the sewer grade is steeper than critical grade.

Bridge design not standardized

In designing and constructing the many bridges and underpasses for the Freeway, standardization was discarded, and each design was controlled by esthetic as well as by functional considerations. Both simple-span and continuous-span bridges are used, some with end bents and others with abutments. Both reinforced concrete and steel girders are used. It is worthy of note that one of the Freeway bridges won first prize in its class in the annual AISC competition for 1949. It is pictured in an accompanying photograph.

Piling driven for these bridges was of all types—treated and untreated timber, H-type, precast concrete, and cast-in-place piles. At stream crossings the well point system was used to lower the water table in the affected area. All railroad bridges were designed in close cooperation with the engineers representing the railroad involved. Both pipe and concrete handrailing are used on the bridges, depending on the location and esthetic value to the structure.

The engineering work is being done by the State Highway Department of Georgia with M. L. Shadburn, M. ASCE, State Highway Engineer; S.P. Allison, Urban Engineer; and M.E. Cox, M. ASCE, Engineer for the Joint Bond Commission.

Tenth Street Bridge on Freeway was prize-winning structure in 1949 American Institute of Steel Construction competition, Class III, for structures with spans of less than 400 ft, costing less than $500,000. Bridge was designed by Robert & Co. Associates and fabricated by Virginia Bridge Co.

ATLANTA FREEWAY

Construction problems are mainly concerned with public relations

B. P. McWHORTER, M. ASCE, Division Engineer, Bureau of Public Roads, Atlanta, Georgia

Design of the Atlanta Freeway was actually begun in the summer of 1947 when a contract was awarded to the engineering consultants, Robert & Company, Atlanta, for preparation of preliminary and construction plans for about 5 miles of the north-south route. A second contract with the John J. Harte Co. was executed in 1948 for an additional 3.5 miles of the same route. On the remainder of the 20 miles of the north-south system, plans have been prepared or are being prepared by the State Highway Department of Georgia.

The core of the Freeway system is the downtown connector, a half loop extending around the north, east, and south sides of the downtown area (Fig. 3). The Freeway extends northward from the downtown connector on a line approximately parallel to and west of Spring Street to a point in the vicinity of Brookwood Station, at which point it divides into two branches, one going northwest and one northeast. The northwest route connects with U.S. Route 41 at Nancy Creek just north of West Paces Ferry Road. The northeast route connects with U.S. Route 23 at the east city limits near Lenox Road. The south route extends almost directly south from the downtown connector to connect with U.S. Route 41 at the Fulton-Clayton County line.

Northeast leg of Freeway, looking east from Peachtree Street at Brookwood Station, is seen under construction. Exit ramp at right was not included in consultant's original recommendations, but was later added to eliminate several thousand left turning movements each day at Peachtree Street. This section has now been completed and opened to traffic.

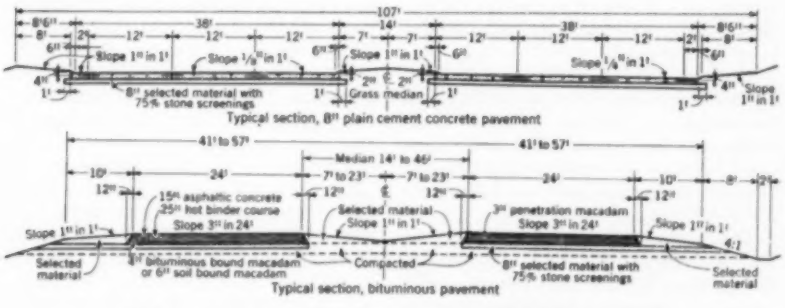


FIG. 4. Several different cross-sections and both concrete and bituminous pavements have been used on Atlanta Freeway.

Plans for the future contemplate two east freeways extending from the downtown connector, one to the north and one to the south of the Georgia Railroad. One west freeway will also be constructed. Its location has not yet been determined, but it will probably be a westerly extension of the southernmost east Freeway.

Several different cross-sections and both concrete and bituminous pavements have been used on the Freeway (Fig. 4). The north route, to the junction of the northeast and northwest legs, has six 12-ft traffic lanes, a 14-ft raised grassed median strip, and two 10-ft 6-in. shoulders (including mountable curb and gutter). The pavement is plain cement concrete 8 in. thick, with subgrade treatment to a minimum compacted depth of 8 in. The downtown connector will have the same cross section, except that a part of it between major interchanges will have eight 12-ft traffic lanes with portland cement concrete pavement.

The northeast and northwest legs have four 12-ft traffic lanes, with median treatments of three different

General design and landscaping give pleasing vistas on north leg of Freeway near Brookwood Station of Southern Railroad. In this area considerable rock was excavated from cuts, and about 100,000 cu yd of it was crushed for stabilizer screenings and concrete aggregate.

Heavy retaining walls were required at several locations. These walls are generally of cantilever design, with vertical grooves 6 ft apart for architectural effect.

types: (1) a raised grassed strip 14 ft wide; (2) a similar strip 14 ft wide with 36-in. curb and gutter on each side; and (3) a paved strip 10 ft wide with 36-in. curb and gutter on each side. Shoulders are either a 10-ft grassed section or are 10 ft 6 in. wide, including mountable curb and gutter. The pavement is plain portland cement concrete 8 in. thick, with an 8 in. compacted depth of subgrade treatment. This treatment consists of selected soil and stone screenings providing a foundation of high stability and "non-pumping" characteristics.

The southerly $5^1/_4$ miles of the south route has four 12-ft traffic lanes, two 10-ft grassed shoulders, and a depressed grassed median strip varying in width from 14 to 46 ft. The pavement is of bituminous type, with an 8-in. depth of subgrade treatment, a subbase of 6 in. of soil-bound macadam (or 4 in. of bituminous-bound course), a 3-in. penetration macadam course, a $2^1/_2$-in. binder course, and a $1^1/_2$-in. wearing surface. The remaining part of the south route, which will have a similar bituminous pavement, is designed for six 12-ft traffic lanes, a 14-ft median strip, and 10-ft 6-in. shoulders—including mountable curb and gutter.

A very similar flexible-pavement design was adopted for the New Jersey Turnpike some months after our design was evolved. The New Jersey design, however, incorporates an additional layer of selected material to provide protection against frost action, a precaution not necessary in Atlanta. All sections of the Freeway are designed to carry 22,000 lb per axle, and each traffic lane is designed to carry 1,500 vehicles per hour.

The Freeway incorporates several sections of heavy retaining-wall construction at locations where it was necessary to protect expensive property. Nearly all these walls are of cantilever design, with heights ranging up to 35 ft. Walls have been treated architecturally with vertical grooves spaced about 6 ft apart.

The lighting system is of the mercury vapor type. Light standards are placed on the shoulders 9 ft from the edge of the traffic lane, approximately 190 ft apart, and staggered. The luminaires, of 16,000 lumen, 230 v, are mounted on mast arms 15 ft long, with a mounting height of 28 ft 3 in. Ramps are lighted with 10,000-lumen, 115-v luminaires placed on one side only, approximately 95 ft apart. Lateral placement, mast arms, and mounting heights are the same as on the Freeway itself. The lighting system has proved very satisfactory.

Design of the Atlanta North-South Freeway has progressed to the point where the entire length has either been designed or plans are in the preparation stage.

Construction activities to date have brought out no unusual physical construction features. The unusual features of the construction operations have been in the realm of public relations and unforeseen or unforeseeable utility adjustments.

For instance, the contractor on the leg from Merritts Avenue to Brookwood Station and on the northeast leg foresaw the difficulties he might encounter in removing several heavy rock cuts by conventional methods and employed a blasting expert who had considerable experience working in metropolitan areas in the East on similar construction. In spite of the contractor's care, some lawsuits have grown out of this work and are yet to be settled.

Property owners are notably impatient of inconveniences caused by construction operations, especially when their trade is cut off even for a few hours. Most of these people, although happy indeed to have the completed improvement, become quite articulate when they see customers denied access to their premises. Better cooperation and understanding on the part of property owners can be fostered through friendly contacts by contractors' representatives and by state and city engineers.

Another item that can cause the contractor many headaches is incomplete information on existing or proposed utilities. Bidders should be furnished with detailed information concerning existing power and phone cables, water, gas, and sewer lines, together with proposed new lines and the measures he is expected to take to protect these installations. Close liaison between the utility companies and the contractor will minimize interruptions to vital services and avoid expensive delays to the contractor.

In construction work of this nature all the contractor's operations must be worked out on a very tight schedule. Delays caused by right-of-way disputes can throw such a schedule completely out of kilter. It is desirable, therefore, that all questions of entry on the right-of-way be resolved before the contractor begins

General view of paving operations on northeast arm of Freeway shows 34-E dual-drum paver being charged from dump truck while finishing machines follow.

Right: Buildings of Washington Seminary, near Brookwood Station, had to be protected by shoring and underpinning. Sheetpiling could not be driven because wall footing extended back too far into Seminary property. Wooden garage at left in upper photo later collapsed.

his operations, or that he be told what obstacles of this nature remain to be cleared.

An interesting problem was posed for one contractor by what was apparently an oversight on the plans. In acquiring rights-of-way at the Peachtree Street crossing between Washington Seminary and Brookwood Station, it was found necessary to build a large retaining wall to protect the seminary buildings. The plans showed the face of this wall to be about 18 ft from the edge of the nearest building on the Seminary campus. When construction was begun it was noted that the footing of the wall extended back into the Seminary property too far to permit the driving of sheetpiling to protect the building, and at this time it was found necessary to redesign the footing, and for the contractor to shore up the embankment face and underpin the building to avoid damage to it. During construction, a crack developed in the earth face about 50 ft back of the excavation and parallel to it. As a result students using classroom space in this building were evacuated as a precautionary measure until the wall was completed and backfilled. Before the footing was completed, an adjacent wooden shack, once used as a garage, was so undermined that it collapsed.

Considerable rock was excavated from cuts near Brookwood Station, and of this material the contractor crushed about 100,000 cu yd for stabilizer screenings and concrete aggregate.

Maintenance and policing of the Freeway is a responsibility of the City of Atlanta. The principal problems of maintenance have been the cutting of grassed shoulders and slopes, and cleaning up of litter thrown from passing cars. To date very little work has been required on structures and pavements.

Policing problems involve speeders primarily, although a few minor cases involving vandalism have been prosecuted. With the opening of the first units of the Freeway, it was found impossible to prevent indiscriminate cutting across the median strip to turn around. Construction of a chain-link fence down the center of the median strip for practically the entire length of the Freeway has made the policing of this phase of driver behavior very simple and has added immeasurably to the safety of the route. It is the cheapest solution we have discovered to provide a physical barrier in the median strip.

The construction schedule for the north-south Freeway, carefully planned and rigidly adhered to, has accomplished many of the objectives that are so vital to the successful prosecution of any freeway program. Construction operations have created a minimum of interference with normal traffic flows. Individual projects, when completed, constitute usable Freeway sections, thus relieving congested city streets and providing early economic benefits that otherwise would not accrue. This is demonstrated by the fact that on one complete section, only about 2.5 miles in length, traffic volumes are already in excess of 30,000 vehicles per day. These volumes will, of course, increase tremendously as each succeeding section is opened.

Areas adjacent to the Freeway are already receiving a complete face-lifting job through high-type developments by private interests along frontage roads and adjacent city streets. Although no economic study has been made, a comparison of the city's tax digest for these areas before and after Freeway construction would, I believe, yield very encouraging data for use in financing other similar facilities.

When the Atlantic Freeway was first undertaken, public sentiment certainly was not 100 percent in favor of it. However, when the first section was opened to traffic in the summer of 1951, the public gave its stamp of approval. There are now 14.5 miles either completed or under construction, and with the opening of each new section, the people asked for more. In short, they like what they are buying.

The Atlantic Freeway, even the entire system, is not and never has been proposed as a cure-all for the city's traffic ills. Other traffic arteries must be built, mass transit must be improved, parking facilities must be provided, and all known traffic regulation devices must be employed and improved upon to the fullest extent. The order is a large one, but now is the time to look ahead toward providing what is needed, not today or tomorrow, but 20 or 25 years in the future.

Contractors on Freeway work, and the amounts of their contracts, are:

MacDougald Construction Co.	$7,489,512
Wright Contracting Co.	2,276,537
E. Jack Smith, Contractor	1,088,734
E. A. Hudson's Sons	497,144
W. J. Tidwell, Jr.	84,151

Standard proposed for indicating the precision of

Any estimate of the cost of a construction project involves a degree of uncertainty, right up to the point where all the bills are paid. At the earliest inception of a project, capital cost estimates may be required that have no supporting data better than an adjusted comparison with a similar project of known cost, and the amount of uncertainty is evidently large. As the design progresses, more and more firm data become available to the estimator, and he may expect to improve the precision of his estimate accordingly.

It is common practice to designate early estimates as "preliminary," or "predesign," or in any other terms implying that high precision must not be expected from them. At some period during the development of the design, another estimate may be prepared and termed "interim." Later an "appropriation-grade" estimate may be submitted. These terms, or similar ones, have no standard relation to the quality of the data available at the time the estimate is prepared. Both the estimator and his client (or his supervisors) have no way of distinguishing between an extremely "preliminary" estimate and a moderately "preliminary" one except by the amount of the contingency allowance. It is not difficult to conceive a set of circumstances in which a preliminary estimate, or one made at an early design phase, might have a precision expectancy superior to an appropriation estimate made for a more complex project. Such ambiguities and the many other inherent possibilities for serious misunderstanding between the estimator and those who use his estimates, make a search for improvement well worth while.

Stiff requirements must be met

A standard system for improving this situation, to be of value, should fulfill some difficult requirements. It should be capable of grading the status of the data as reflected in expected precision—if not in a literal statement of data at hand, and data missing. It should be easily adaptable to present practice. It should be capable of covering the status of the data for nearly every type of construction. Above all, it should be simple. If a system cannot meet these requirements, it will not gain acceptance among those who would benefit most from it—the professional engineers, architects, contractors and their clients.

In any estimating method, it is customary to express the estimator's judgment of the hazard of overrun in the contingency allowance. As previously mentioned, a user may infer the precision expectancy from the relation of the contingency to the basic total. Expressed as a percentage, the contingency allowance becomes a final summation of the estimator's appraisal of the combined quality and precision of the data. According to common practice today, however, this element of an estimate is set down quite frequently as an arbitrary figure, in even multiples of 5 percent.

If, having arrived at his basic total, the estimator should make a calculation of the possible overrun and underrun of the major components, he would arrive at two figures that would state precision expectancy in the most exact terms possible, and would reflect data status concisely.

An example of method

For illustration, consider an estimate for an industrial plant made at a time when the equipment list, outline structural and architectural plans, site surveys (including soil investigations), and flow sheets are complete but power wiring, piping, and instrumentation data are lacking. Quotations covering the equipment have not all been received, so this component needs an allowance of $100,000 over, and $25,000 under, the indicated subtotal. There is a possibility that water supply may require a greater length of pipeline to improve intake conditions, and this requires $100,000 over. Buildings and structures, having been computed from recent bids, need $250,000 each way.

Piling needs $50,000 for length overrun, and $25,000 for underrun. Storm and process drainage systems have not been designed, and need $50,000 over. Piping, most elusive of the components, needs $1,000,000 over and $200,000 under. And power wiring, with fair definition from the equipment list, needs $200,000 over and $50,000 under. Overhead, including engineering costs, needs $100,000 over. The estimator judges that an allowance of $500,000 to cover instruments, minor design

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construction cost estimates

changes, and deficiencies in the data is also needed.

The total of estimated overruns is $2,350,000 and of underruns, $550,000. A basic total of $14,500,000 would make the precision expectancy 20 percent. It is necessary to include, within the basic total, sums to cover every conceivable item of cost, but the practice of "loading" some of the components to avoid an unusually high contingency (or precision expectancy) ratio, is plainly precluded if the method is to be expressive and adapted to wide use.

Misunderstandings avoided

Some really startling ratios might be produced under certain circumstances. While this could create awkward situations between service firms and their new clients, it appears that they would be reconciled by a full explanation. If this explanation, together with a low precision expectancy, shows that the estimate grade is insufficient for the user's purpose, there is no recourse but to take the time required and complete the design and investigations necessary to improve the data. In any event, it appears that the fundamental purpose of avoiding serious misunderstandings would be well served.

It is only, then, in the matter of explaining how and why the supporting data are imperfect that this calculated contingency method of grading fails to satisfy the imposed requirements. Without explanation, it is too concise in expressing data quality. It is, however, customary to submit with any estimate a definition of the scope of the project as visualized by the estimator, and to list any items of cost not included within the estimate. An extension of this practice to include a statement describing the condition of the data as the estimator has found it is not therefore out of place, and would answer the requirement for clarity. An itemized tabulation of the contingency calculation should be included with the estimate also.

It should be noted that future price changes are not covered by the estimate, and that a separate statement and calculation of their influence should be submitted if the user requires the estimator's prediction on them. The precision expectancy should be stated as a percentage in a prominent place.

Terminology to be used with this method is only a matter of preference. The anticipated lowest cost might be termed "estimated minimum total cost"; the basic total, "probable total project cost"; and the overrun figure, "estimated maximum project cost." It is superfluous to qualify further with a term such as "preliminary" in the title of the estimate. "Estimate of construction cost," or another such simple heading would be appropriate.

Someone may ask why a system of alphabet letters should not be adopted to designate the several grades of estimates, such as A, B, etc. For example, Class E might be assigned to an estimate made for an industrial plant when the data were in the condition discussed in the example previously given. This would be sufficiently specific for practical use on all similar industrial plants. But what would Class E mean if it were applied to a port terminal facility, where piling length might be the only uncertainty of real consequence? How could such a designation convey the fact that, in one case, the estimate was prepared with a substantial background of cost records, and in another case with few or none? It is evident that any such code system for expressing data status for more than one type of project would be so complicated that it would defeat its purpose, and must be dismissed.

Proposal summarized

It is proposed, then, that the relative precision of any construction cost estimate be reported to its user by a system of percentage figures computed from an evaluation of each uncertainty inherent in the supporting data, with a statement of why the uncertainties exist. This system promises an improvement in understanding among all those concerned with estimates. It can be simply adapted to any estimating method, and to any type of capital expenditure. Certainly many embarrassing misunderstandings can be avoided by adoption of this method of indicating the degree of precision of construction cost estimates.

(This article was prepared from the paper presented by Mr. Wrigley at ASCE'S Atlanta Covention, before the Construction Division session presided over by Harold W. Hunt, secretary of the Division's Executive Committee.)

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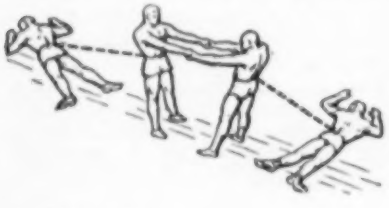
Materials combined to advantage—

concrete in compression, steel in tension

The Livestock Judging Pavilion at Raleigh, N.C., is both visually and structurally arresting. To the engineer, its most noteworthy feature is perhaps the use of materials—steel cables in tension to take the roof loads, and inclined, reinforced-concrete arches in compression to take the loads from the cables. The thrust of the arches is in turn taken by concrete tripods with prestressed underground ties to prevent slipping of the footings. The cost of the completely equipped structure is $1,500,000. This article deals with the structural concept underlying the design of this unique building.

The action of the two arches may be considered similar to that of two men having a tug of war. Their weight, leaning back, is in dynamic stability, with pull in their arms.

Conventional suspension systems, on the other hand, are static and require some sort of tie-back. If we were to continue the parallel of the men in a tug of war, we would require two extra men, the "deadmen," to provide the stability achieved by the two men in the upper sketch.



This may be an oversimplification of the structural principle, but the concept is accurate. The two parabolic arches (Fig. 1), supported on the fireproof structural steel columns of the pavilion, are frozen into this tug-of-war position, while the steel cables (the arms of their human counterparts) span and support the roof.

The shape of the roof, a saddle, gives the opportunity to resist both downward and upward forces. The catenary system, spanning between the arches, resists downward forces, and the arched cables passing over the saddle resist uplift. It was soon realized from engineering principles that such a system of crossing cables, without sufficient prestressing, would be subject to fluttering. This was demonstrated by wind tests on a scale model. Futhermore, the cross-cables away from the intersections lost their convex curvature. It became necessary, therefore, to provide guide cables at the ends of both systems of cables.

Originally a fabric roof was considered, but the material available at the time of bidding was more expensive than the roofing adopted—the H. H. Robertson Galbestos steel deck covered with rigid insulation and roofing. With this relatively stiff roof deck, the tendency to flutter is reduced, but not sufficiently to risk elimination of the guy wires, which are designed to take the full unbalanced load without the benefit of the roof deck. Not only safety is involved, but also the integrity of the roofing membrane. The guy wires are connected to the main cables with Crosby clips, which are a kind of U-bolt. A pressure of 5,000 lb was applied to the top of the clip while the bolts were tightened. In some places several clips were used together.

To ease impact forces and to make the guy wires effective under varying temperature conditions, these wires are equipped with adjustable springs with load indicators. Springs were designed under the following assumptions:

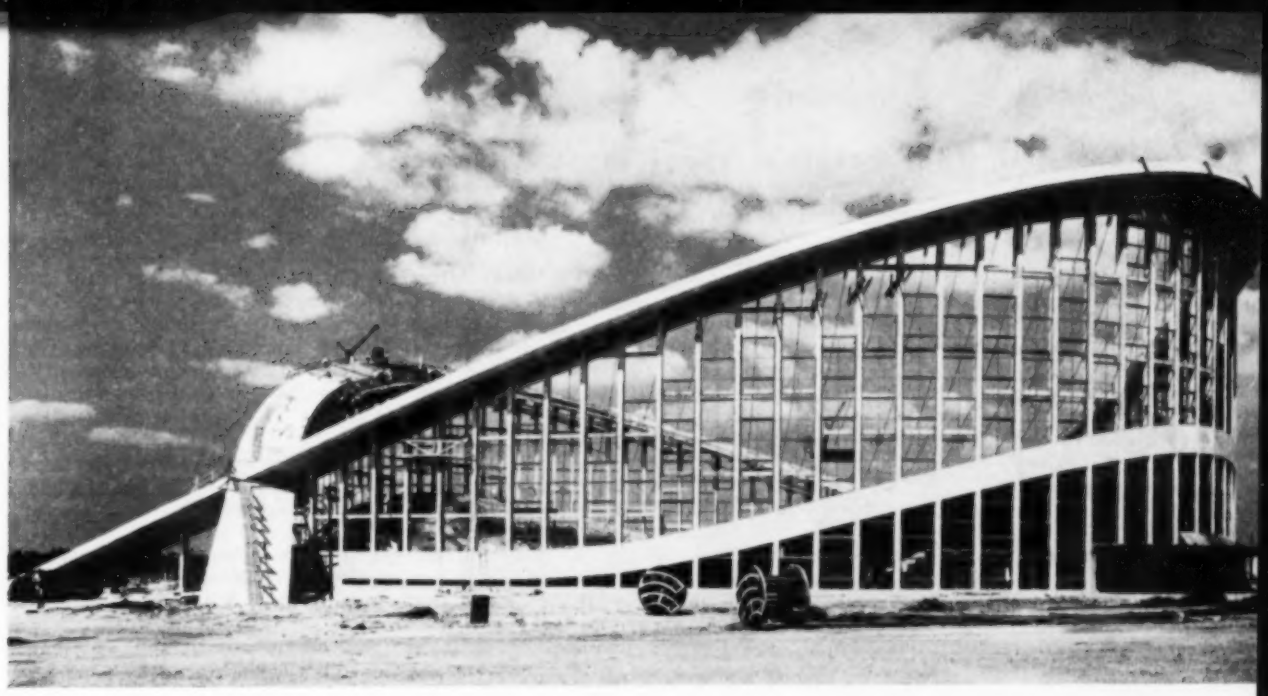
1. At plus 120 deg F the spring scale has to show zero (equal to a $^1/_2$ in. deflection).

2. At minus 10 deg F the load on the spring would be such that, when increased by 33 percent, the spring would be brought to maximum deflection (equal to $3^1/_2$ in.).

3. For a net uplift of 10 psf on the roof, the spring deflection should be 3 in. (equal to $2^1/_2$ in. on the scale).

Assumption 1 had to be taken care of during erection. Assumption 2 as controlled mathematically for the longest guy wire. Assumption 3 was the basis for determining the spring sizes.

An analysis of the temperature and shrinkage stresses in the concrete



Livestock Judging Pavilion at Raleigh, N. C., employs parabolic arches of concrete to form saddle-shaped roof. Arches take loads from roof cables which criss-cross transversely and carry "floating" roof of steel decking.

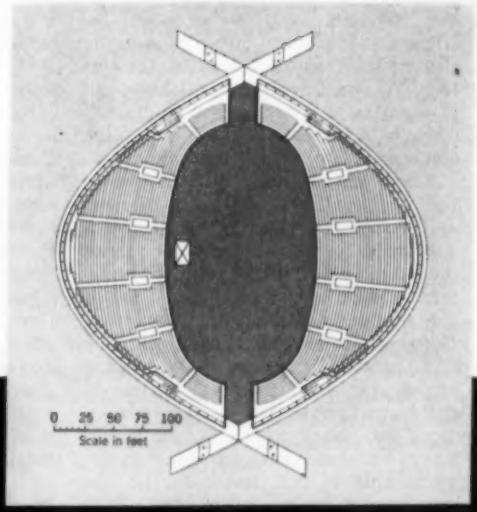
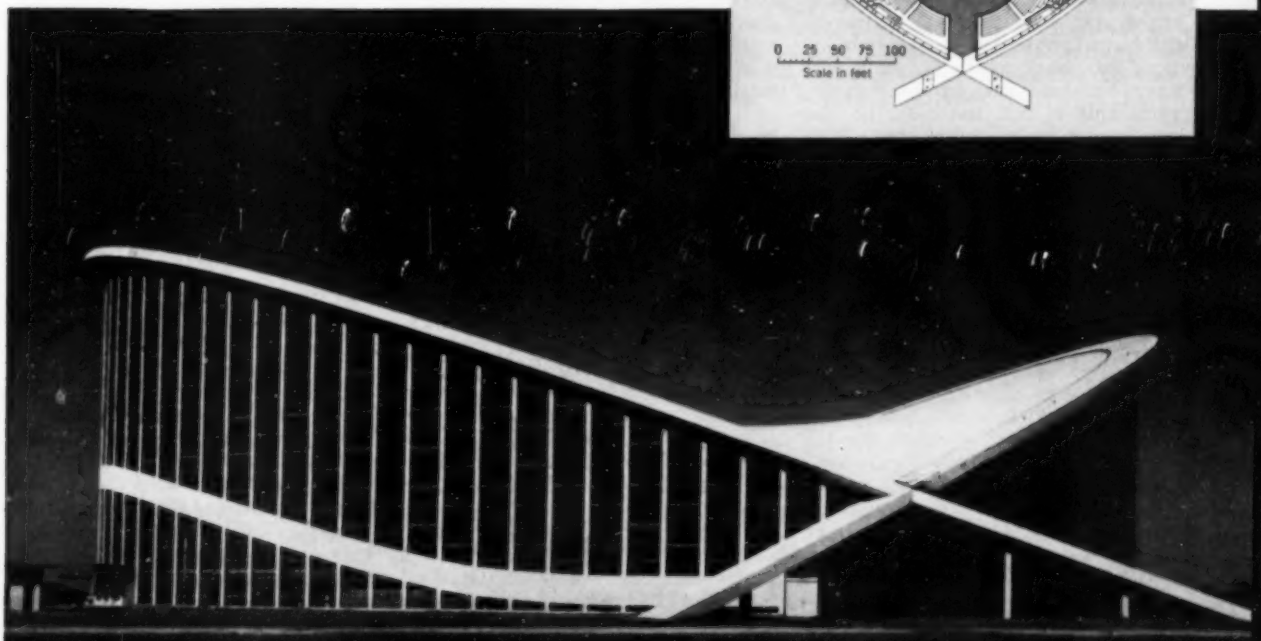


FIG. 1. Parabodic arches of North Carolina Livestock Judging Pavilion rise to height of 90 ft. Uppermost seats are 34 ft above ground. Dead load of arches is taken by concrete-encased steel columns.



arches indicated that relief at the intersections was essential. This was afforded by steel hinges as shown in Fig. 2. The location of these hinges is indicated in Fig. 3.

Above the arch intersections a clear-cut structural situation exists. Below this point the situation is different. The continuations of the arches are not structurally part of the arches but are members of a "tripod" supporting the arches. This tripod has three legs, two of which are the extensions of the arches and the third is the center column directly under the intersection. For ideal and balanced conditions, this column takes no load. However, for varying conditions of wind and snow load, it may be either in tension or in compression. In other words, the tripod has a tendency to tip either in or out. Under an outward tipping action, the center column serves to tie the tripod down, but with inward tipping it acts as a compression member. This column is therefore a vitally essential element of the structure.

The sloping arch continuations carry the major thrust of the arch load and therefore are subjected to heavy compression. To prevent these members from buckling, and to minimize movements due to the load of the members themselves, two additional columns are introduced.

To prevent slipping of the sloping tripod members, it was essential to secure their bases. If a rock foundation had been available, it would have answered the purpose. However, this is not the case, as the structure is built on firm clay. The forces involved are so great and act at such an acute angle to the ground that a very positive means of preventing slipping was essential. It was decided, therefore, to tie these two sloping tripod legs together at their bases by an underground horizontal tie.

The following factors could have given trouble and required careful consideration: (1) The sloping arch extensions shorten under load; (2) being of concrete, they also shorten as a result of shrinkage; (3) temperature drops produce another reduction in the length of these arch extensions; and (4) the horizontal tie lengthens under load.

All these factors result in a lowering of the arch intersections, and unless controlled would create a tremendous load on the center column, upsetting the whole stress pattern. If the column were to be proportioned for the large forces engendered, it would have to be of great size. It would then have to take the whole load, which would require allowance for horizontal forces. This would not only leave the sloping legs of the tripod limp and inactive, but would also cause them to crack, unless special precautions were taken to counteract this tendency. If, on the other hand, the column were proportioned for load only, without taking into account the factors enumerated above, it might buckle at one time or another. Were it to fail, the load it formerly carried would be dumped on the sloping members of the tripod, which, unable to lean on it, would likewise fail, and the whole structure might collapse.

It is therefore very important to reconcile these conflicting forces. This was done in several ways: (1) by making the center column adjustable, both for compression and tension; (2) by adjusting the columns near the arch intersections at their bases to prevent them from absorbing too much load as the intersections deflect; and (3) by progressively stressing the horizontal tie as the form work was removed and the load on the foundations increased. By carefully coordinating the adjustments of all these members, an equilibrium was finally obtained such that further fluctuations would be so small as to be of no concern (Fig. 3).

Pouring of anchor footing

Footings were excavated to grade and the bottom leveled. A sump hole was provided outside the footing area, but it was anticipated that pumping would be required only in the event of a shower. The bottom was then sealed with a layer of concrete 1 in. thick to give a clean working area. Footing walls were formed and braced with conventional wood forms. Short 4 × 4 × $^{3}/_{8}$-in. angles 6 in. long were welded to the inboard face of the $^{7}/_{8}$-in. steel bearing plate under each cable hole. These angles form a trough seat in which the fiber conduit rests.

The bearing plate was set to line and grade, then bolted to the wood form. Next, the bottom mat of steel for the footing was placed, tied, and blocked.

Fiber conduit to carry the prestressing cables was placed in 8-ft sections, and joined with asphaltic cement and Harrington-type sleeves. Conduit joint centers are approximately 8, 15, and 23 ft from the bearing plate. Conduit ends project about 1 in. through neat holes in the bulkhead on the tunnel end of the footing. To support and maintain the alignment of the fiber conduit during pouring, plain concrete piers 8 in. × 10 in. in plan were poured at each joint in the fiber conduit in the lines where two conduits were placed one above the other. In the line where one conduit occurs, a strut 6 in. wide and 8 in. high was formed and poured between the piers.

The sequence of placing and prestressing the cables was as follows:

1. The north anchor footings were completely poured.

2. The south anchor footings were partially poured starting at the tunnel end of the footing and pouring out to a point approximately 8 in. away from the bearing plate.

3. The anchor cables were received from Bethlehem Steel Co. with one button socket attached. Cables were threaded through the north footing and through the tunnel. An air winch and cable grip were used to haul the cables.

4. As the cables were pulled through the south footing, they were threaded through their respective holes in the bearing plate, which was supported in a horizontal position. The cables were bent to project through the plate in a vertical position for socketing.

5. Each cable was then socketed at a position previously marked on it. This marked position was 184 ft 6 in. from the opposite button socket. The mark was made after the cable was prestretched but before it was loaded.

6. When socketing was complete, both bearing plate and cables were lowered to the correct vertical position. The bearing plate was then jacked out to make the button sockets bear, and braced in position against the part of the footing already poured. Cables were encased in split fiber duct sleeves and the duct wrapped with an asphalt-saturated membrane. The rest of the footing concrete was poured behind the bearing plate.

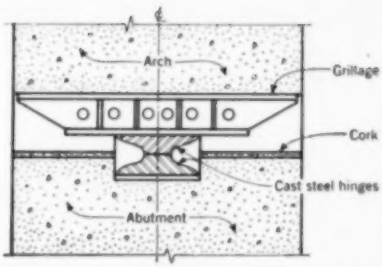


FIG. 2. Hinges are provided at point where arches join abutment. Action above hinge is that of simple arch while that below is of more complex compression member.

7. Actual prestressing operations were carried out at one end of each cable in accordance with a prescribed sequence. The south footing sockets have two plate ears welded to opposite sides, which were provided with a pin hole of proper diameter. A 2-in. threaded connecting rod was pin-connected to the socket ears. The jacking mechanism used was a simplex Jenny-type jack with a hollow center, of 100-ton capacity, equipped with a gage. A jacking frame was used to block the jack off the bearing plate. As jacking progressed, slotted steel shims were dropped over the cable between the socket and the bearing plate. To secure the final position of the socket, two steel-plate wedges were driven in from opposite sides to firm bearing.

We believe the fundamental principles embodied in this structure will lead to many interesting developments; in fact we have some under consideration right now. High-strength cables which gain their efficiency by simply being hung with the proper sag represent just about the acme of economical and direct use of materials. If elements within the structure can be found to lend proper anchorage, at the same time serving other functions, by all means think of "floating" roofs.

Full credit for this daring and original concept must go to the late Matthew Nowicki and to the office of William Deitrick for carrying the concept through to its completion. The author was structural consultant for the project. William Muirhead Construction Co. was the general contractor.

(This article was prepared from Mr. Severud's paper presented at ASCE's Annual New York Convention, before the Structural Division session presided over by Raymond Archibald, Chairman of the Division's Executive Committee.)

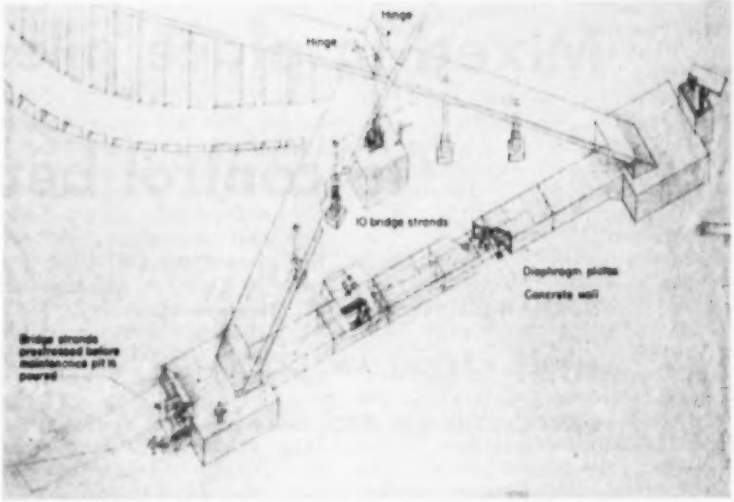
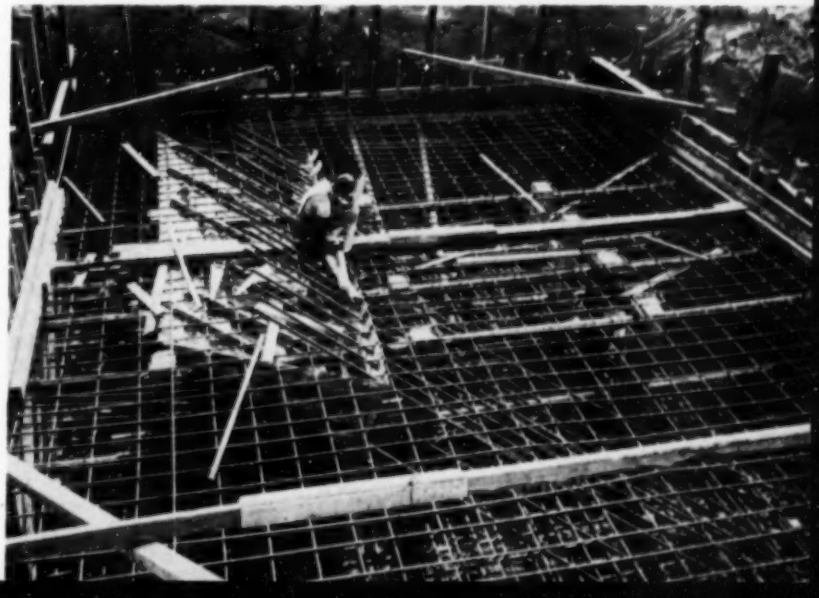


FIG. 3. Cutaway sketch shows arrangement of concrete footings and tunnel with prestressing cables which tie system together. Column at intersection of abutment legs has variable height to permit adjustment as arches are progressively loaded. Prestressing was coordinated with progress of construction of arches.

Footing for arch continuation (Fig. 3) was heavily reinforced in plane of thrust. Conduits for cables which will tie footings together can be seen running through footing just under top layer of reinforcing. Cable tunnel extends to left.



While crane is still extending sand-filled jetty, mixed-in-place pile rig begins work at shoreward end.

Mixed-in-place piles form jetty to control beach erosion

NORMAN L. LIVER, J.M. ASCE, Foundation Engineer

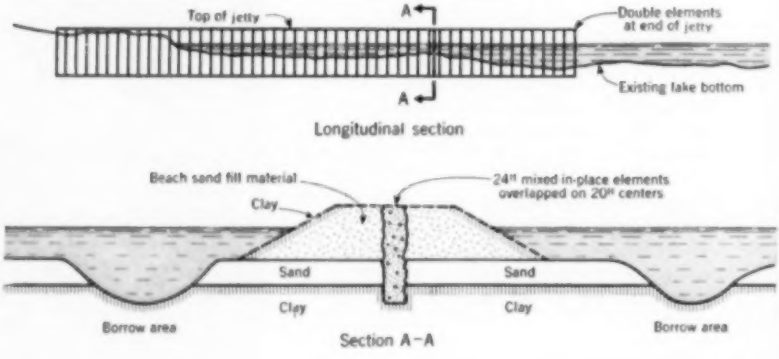
ERWIN C. MARDORF, A.M. ASCE, Engineer

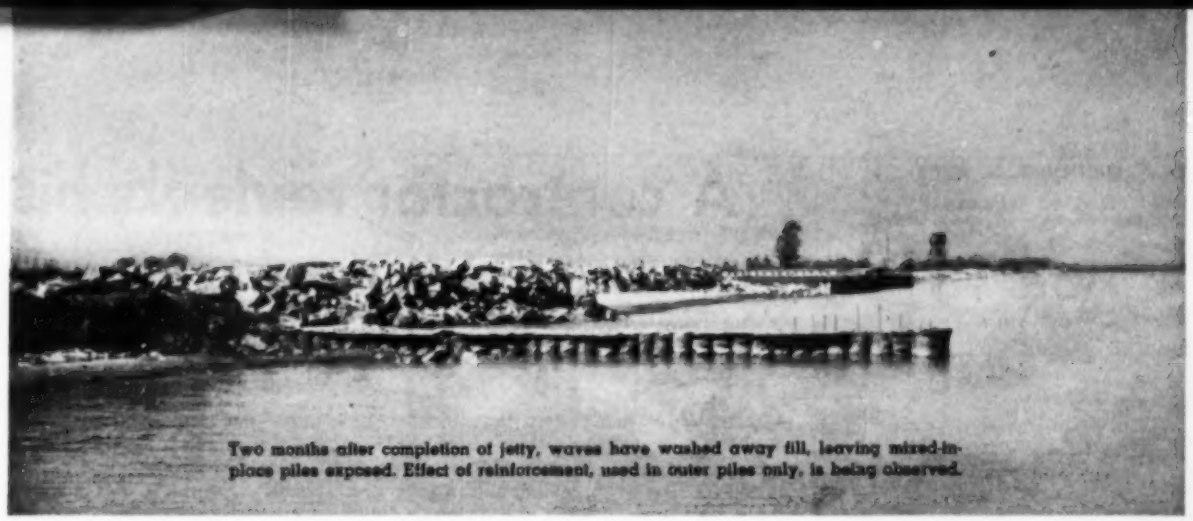
JOHN C. KING, A.M. ASCE, Chief Engineer

Intrusion-Prepakt, Inc., Cleveland, Ohio

Single truck carries grout mixing and pumping equipment as well as equipment for placing mixed-in-place piles—only plant required for operation. Unit can work to depth of 30 ft, and for greater depths additional lengths of drill rod can be added. Mixing heads vary from 12 to 24 in. in diameter. Controls are so arranged that single operator can handle entire operation.

FIG. 1. Jetty was built out into Lake Erie by drilling mixed-in-place piles in overlapping chain through center of sand fill, built by clamshell.





Two months after completion of jetty, waves have washed away fill, leaving mixed-in-place piles exposed. Effect of reinforcement, used in outer piles only, is being observed.

In an experimental program to prevent beach erosion at Camp Perry, Ohio, near Sandusky on the shore of Lake Erie, a jetty extending out into the lake was constructed of mixed-in-place Intrusion grout piles. The first step in the construction procedure was to build up a sand-fill roadway projecting into the lake about 120 ft. On this roadway the pile mixing rig could operate. The fill was dredged from the adjacent shore area by a crawler crane using a clamshell bucket. The roadway was about 12 ft wide and required about 200 cu yd of fill.

The rig then placed the piles along the center-line of the fill, as shown in Fig. 1. These elements are 24 in. in diameter and vary from 8 to 10 ft in length. The piles overlap slightly so as to form a continuous wall having a total length of 96 ft from the sea wall to the tip of the groin.

In some of the piles at the offshore end, steel reinforcing was added. As the jetty ages, comparisons will be made to determine the effect of this reinforcing, and whether it is necessary.

This jetty, including the sand fill into which the piles were driven, was constructed in 16 hours of working time.

This process of mixed-in-place Intrusion grouting has been perfected after a decade of research and development. (See CIVIL ENGINEERING, February 1953, p. 74.) The process consists of injecting a neat or sanded Intrusion grout through a hollow shaft to a rotating mixing head provided with vanes. As the head is forced down, grout is mixed with the soil in place. The result is a pile-like column of considerable load-carrying capacity. Since the setting time of the material is slow, reinforcing steel can be placed in it from the top, after the mixing head has been withdrawn.

Grout mixture used

Intrusion grout contains the admixtures Alfesil and Intrusion Aid. Alfesil is a finely divided siliceous material which reacts with the lime liberated during the hardening of portland cement to form insoluble, strength-producing compounds. Intrusion Aid, in appropriate small quantities, imparts to the grout the properties of a colloidal suspension, reduces the water requirement for equal fluidity, delays the early stiffening of the grout, and reduces or eliminates setting shrinkage.

The amount of Intrusion grout mixed with the soil is dependent on the volume of voids in the material. The quantity pumped varies from 30 percent in fine sands and compacted clays to 60 percent in loose sands and soft clays. The amount used at Camp Perry was 28 percent.

Lateral spread in porous zones frequently increases the grout take, but additional stabilization is obtained at the same time. The strength of the pile is largely dependent on the soil encountered, but it can be adjusted to some extent by changing the composition of the mix. Also, in soils that take a low percentage of grout, a greater quantity of grout can be pumped, thus forcing some of the soil from the hole, to be replaced by the grout.

Intrusion grout mixes vary from 2 bags of portland cement, 1 bag Alfesil, and 15 gal water, to 3 bags portland cement, 1 bag Alfesil, and 17 to 20 gal water, plus Intrusion Aid in the amount of 1 percent by weight of the cementing materials. The mix used at Camp Perry was 2 bags portland cement, 1 bag Alfesil, and 15 gal water, plus Intrusion Aid.

After the experimental laboratory program had been successfully carried out, field equipment had to be developed, capable of placing the piles on actual jobs. The result is the mobile, truck-mounted rig shown in a photograph.

The depths to which the piles can be placed vary with the type of soil and the diameter of the column. Operational difficulties, which develop when very stiff soils are encountered, limit the depth to the torsional force which can be exerted to turn the mixing head. When the force required to turn the head equals the power of the machine, the depth limit has been reached. In experimental work and on actual field jobs, the following depths have been obtained: 12-in. diameter, 58 ft; 18-in. diameter, 50 ft; 24-in. diameter, 30 ft.

The procedure is still in its infancy, but sufficient experimental and field work has been done to warrant its wider use on actual jobs.

Preliminary planning and conception of the mixed-in-place process, as well as the development of the equipment, should be credited to L. S. Wertz, president, and Lee Turzillo, vice president, Intrusion-Prepakt, Inc.

On the jetty at Camp Perry, Ohio, F. O. Kugel, Chief, Division of Shore Erosion, Department of Natural Resources, State of Ohio, was in charge of the work for the state. Norman L. Liver, co-author of this article, was in direct charge for the contractor, Intrusion-Prepakt, Inc.

(This article is taken from the paper presented by the authors before the Soil Mechanics and Foundations Division session presided over by George F. Sowers, A.M. ASCE, at the ASCE Atlanta Convention.)

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A contractor reviews his at Clark Hill

Specifications required forms for powerhouse to be designed for full hydrostatic head. This requirement, coupled with 5-ft vertical spacing of form ties, increased amount of wood used per square foot of form area significantly above amount commonly needed on commercial work.

Construction men know that most construction problems they encounter are not new—merely old tribulations in new disguises. Field problems, though often encountered, rarely fail to develop some unusual quirks. Construction of the powerhouse for the Clark Hill Project was no exception.

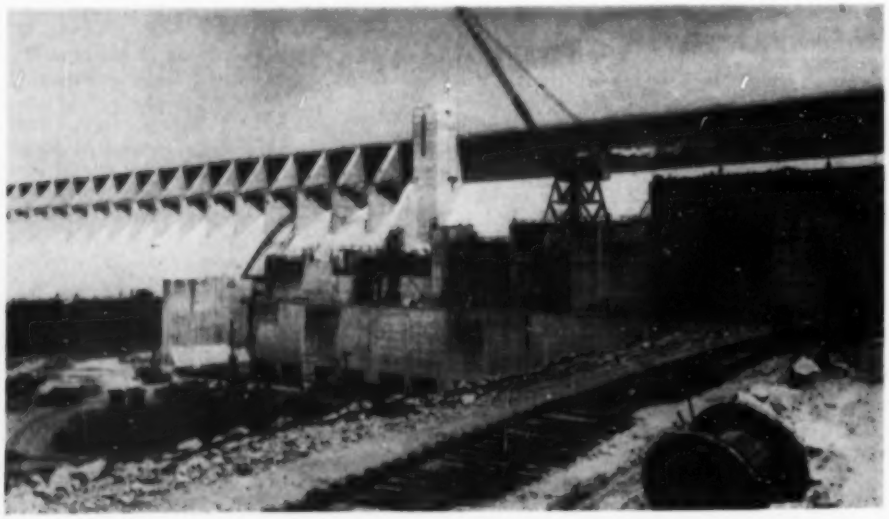
Clark Hill Project, a part of the Savannah River Basin development for multipurpose use, began to take shape on October 15, 1948, when the first concrete for the dam was poured. By 1950, with the dam nearing completion, a contract was let to Bateson-Stolte for the construction of the powerhouse. Nestled at the base of the dam on the South Carolina side, the powerhouse is 556 ft long and contains seven turbines rated at 55,000 hp at 136 ft. The seven 40,000-kw generators have a potential yearly output of 703,000,000 kwhr. Adjacent to the powerhouse site is the switchyard, hub of the power distribution system.

Construction problems presenting themselves included: (1) procurement of material, (2) procurement of labor, (3) development of construction methods to meet inspection requirements, and (4) construction operations in the confined area of the job site. As for the record heat, unusual cold spells, and plentiful moisture—these must just be attributed to the breaks of the game.

Situations discussed in this article are specific examples and existed only until a solution was reached. Assistance in handling these problems was received from the Savannah District Office of the U. S. Engineers and, where needed, from the close cooperation of the local labor unions. Our appreciation is extended to these agencies.

Problem 1, procurement of material

When the controlled material plan was instituted by the government shortly after the contract was signed, many futile days and sleepless nights were spent seeking specification materials. Certainly, materials were available in small quantities at black market prices. But what contractor could risk purchasing such materials without obtaining mill tests certifying grading, color, and the many other specific requirements of the specifications? The black market offered its materials at premium prices, "where-is" and "as-is," "take-it-now or someone-else-will." It was only after the project was endangered that, with the concerted effort of the local citizenry, the material problem was given the necessary official assistance to prevent a stalemate.



Staining of concrete by curing water, in second summer of construction, necessitated extensive refinishing. One theory attributes staining to decay of uncleared vegetation left in the reservoir area.

headaches Powerhouse

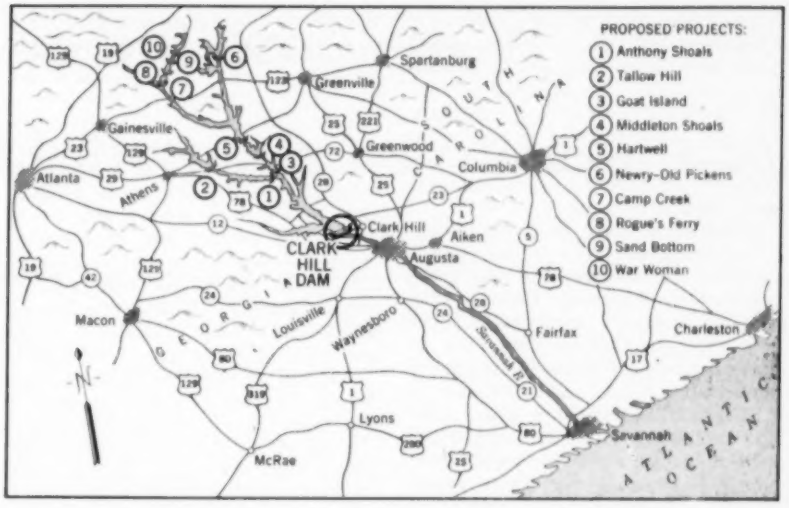


FIG. 1. Clark Hill Project is one of major parts of Savannah River Basin Development. Maximum water storage behind Clark Hill Dam will be 2,900,000 acre-ft, and total yearly power output will be 703,000,000 kwhr.

Problem 2, procurement of labor

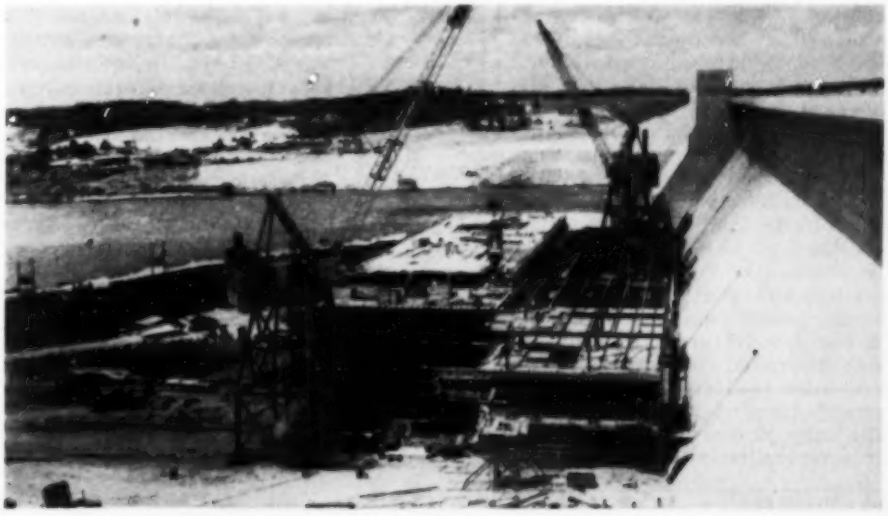
The services of a crystal-ball gazer should be offered every contractor. What problem could possibly arise with the supply of labor in the center of the South, where so many new industries had been drawn by the abundance of low-cost labor, especially after a prebid check indicated this to be true of the project area? A crystal gazer could have foretold that a local military base was to be reactivated, demanding great quantities of skilled labor, and perhaps he could have revealed that a multi-billion-dollar atomic project was suddenly to be located less than 50 miles away. Unfortunately crystal gazers are rarely available to the estimator. Special legislation permitted the atomic project to offer unlimited amounts of overtime at premium wages which were in excess of the going union scales. Premium scales were raised once, twice, yes, several times, until rates were at least 140 percent of former schedules. Construction schedules had to be met and 54-hour work weeks with premium wages were necessary.

Problem 3, local inspection requirements

Form design as specified in the contract was extremely expensive. Pours were low, being restricted to 5 ft in most instances. Regardless of rate of pour, height of pour, temperature of concrete, or any other factor, the inspection forces required the forms to be designed for the full hydrostatic head, assuming no setting of the concrete whatever. As a result, the amount of wood used per square foot of formed surface was nearly triple that used for standard commercial building construction.

Concrete for the powerhouse was placed primarily by low-slump concrete buckets with tremie trunks to prevent segregation while passing through reinforcement zones. An extensive review was made by inspection forces before accepting a batch plant and mixing equipment at the start of the job. Presumably this care was to assure careful control and uniformly mixed concrete of proper strength and with proper consistency for placement. In practice, the main control considered was the consistency meter.

Satisfactory concrete, to the inspection forces, was only realized when the consistency meter indicated "dry," and it became necessary to vibrate the concrete to dump it from a low-slump bucket. Wet or high-slump concretes are not necessary or desirable. However, when aggregate-cement and aggregate-void ratios are ignored, the resulting harsh mix usually uses more water with a lower strength than would a proper dry mix and serves to measurably in-



Addition of second whirley crane to construction plant greatly facilitated erection of powerhouse. Whirley crane here seen between dam and powerhouse was eventually moved to downstream face of powerhouse.

crease the difficulty of placement. Correction of this harshness could have been accomplished by adding more cement, as provided in the specifications for the job. Supposedly for economy, the cement content was always held at the minimum and thus the quality of the concrete was allowed to vary.

Patching of form tie-holes created an amusing situation to an outside observer but an expensive one to the contractor. Patching time of tie-holes customarily varies with each job depending upon the time of stripping forms, the method of curing, the exterior finish, and other factors. At Clark Hill Powerhouse it was mandatory that tie-holes be patched immediately after the stripping of forms, which was during the water curing period. The rapid flow of cure water would then wash away the fresh patch material, necessitating the repatching of the holes. More curing caused the same result, and around and around went the cycle.

Curing water, although not a problem at the beginning of the job, developed an unusual twist. A plentiful supply of water was available from the Savannah River, which was coagulated and settled in a detention pond. This system worked fine for a time. In the second summer of construction work, however, extensive staining of the concrete by the cure water developed. At about the same time the sulfide stench from the river was unpleasant, and almost overnight red-lead primer on structural steel turned gray and black. Remedial treatment was not developed until this surprise attack of stain had covered many areas of the superstructure, necessitating additional finishing of the exterior walls at the completion of concrete construction. There is some uncertainty as to the origin of the stain and odor, but one commonly accepted theory attributes the change in the water to decaying vegetation not removed in clearing the Clark Hill reservoir site.

Combined with the problem of removing curing water from the inside of the structure was the removal of tons of sandblasting sand. This sand accumulated from cleaning the many construction joints created by the requirement of 5-ft pours. Consideration was given to cutting the freshly poured joint with a water jet to eliminate this sand. But when it was discovered that invariably the inspectors required a recleaning by sandblasting just before the next pour, the water jet cleanup was eliminated to save duplication of labor.

Problem 4, confined job area

As is usual with this type of construction, where storage space immediately adjacent to the site is limited, forms were prefabricated in a mill yard and transported by truck to the powerhouse site. The heavy weight of these forms made it necessary to set them with a crane. At the outset of the job, one whirley crane handled forms and reinforcing steel, and placed concrete and all other materials. Later it was deemed advisable to add a second crane and thus improve job coordination.

As steel was not available for a new trestle on the downstream face of the powerhouse, material was handled by the first whirley crane on the site of the trestle used for dam construction, that is, between the powerhouse and the dam. Later, interference with the construction of transformer areas required the removal of this trestle a section at a time, and eventually called for the transfer of this whirley crane to the downstream face of the powerhouse. This transfer was accomplished by constructing, above the partially finished building, a cross trestle which terminated in a tower on the downstream side of the powerhouse. From this location, the remaining building construction was completed and the whirley subsequently dismantled.

A Monday morning quarterback's hindsight on these operations has confirmed our earliest thought that two cranes are better than one and should have been located on the downstream face of the powerhouse from the beginning.

Experience on this job has confirmed what every contractor knows, that every construction project has individual characteristics and must be treated accordingly.

(This article has been prepared from the paper presented by Mr. Giddings at ASCE'S Atlanta Convention, before the Construction Division session presided over by Ben C. Gerwick, member of the Division's Program Committee.)

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor.—H. J. Gilkey

The steel erection of a large industrial one-story building proved to be a unique problem. The floor was a reinforced concrete suspended slab on pile-supported foundations. The floor covered an area of 300 × 500 ft, and the columns were on 50-ft centers. The contractor had originally planned to use a Bay City crane to erect his steel. The crane would be used to transport the prefabricated columns and trusses to the proper location and to provide the lift for erection. The floor slab was designed for a live load of 250 psf and the weight of the crane plus any load exceeded this. The architect-engineer was consulted but would not take the responsibility for allowing any overload. The contractor could not afford to take the risk of failure. The floor area was too large to work from the outside, and other methods would entail extra time and money. How would you erect the steel and still meet the time schedule? For solution, see page 112.

EDITOR'S NOTE: This is the twenty-second in a series which started in the February 1952 issue of CIVIL ENGINEERING. In the April 1952 issue an article, "The Unexpected in Engineering: The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present; that "The engineering of today rests upon a coral reef; sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it? H.J.G.

The above problem was submitted by J. C. LeDoux, J.M. ASCE, Lieutenant, CEC, USN, Naval Supply Center, Norfolk, Va.

Small delays—a big problem on highway construction jobs

FRED B. FARRELL, Chief, Highway Cost Section, U.S. Bureau of Public Roads, Washington, D.C.

Do highway contractors get the most out of their equipment? The question is a challenging one. It is a matter of concern to the contractor, the manufacturer, and the engineer. It is a matter of importance to the public that ultimately pays the highway bill.

The contractor knows that equipment must be kept moving if job costs are to be kept in line. Equipment down-time must be avoided whenever possible. Down-time is usually thought of as a substantial interval, say 15 minutes or longer, when the equipment does not work for one reason or another. During this time costs inevitably pile up, particularly when the labor crew is on the job.

Minor delays, the small persistent time losses of less than 15 min each, are ordinarily considered a part of the working time. Costs pile up during these minor delays, too, since they take place when work is under way and expenses are at a maximum. They average less than a minute per occurrence, but in total they absorb one-fourth of the working time on the average construction job.

There is no uniformity in the duration of minor delays. On dual-drum pavers, they average 20 sec each; on scraper grading units, they average 70 sec. The average duration, by itself, is not of particular importance. But it does show that casual observation alone cannot give a clear indication of the effect of minor delays on job production. A stop-watch in the hands of a trained observer has proved the most effective means of determining their magnitude and classifying them as to cause and effect.

Over the past five or six years, the Bureau of Public Roads has made such stop-watch time studies to find out the kinds of minor delays that occur during working time on various jobs and their effect on production. Over 140 different highway construction projects have been studied in all parts of the country. Jobs were selected at random but were reasonably typical of primary road construction in rural areas. Time studies were made for a period of two or three weeks on each job during active construction.

From among these studies, certain key units of construction equipment have been selected to illustrate the importance of minor delays. These key units include 29 asphalt plants, 23 dual-drum pavers, 40 power shovels, 68 crawler tractor-drawn scraper units, and 74 rubber-tired tractor-drawn scraper units.

The following discussion is confined to "working time," which is considered as the sum of the actual productive time and the minor delays of less than 15 min each in duration. Weather delays and all other major time losses, where the down-time was 15 min or more, have been excluded. Although these longer delays have a vital effect on job performance, they have been excluded in this study so as to focus attention directly on the problem of minor delays.

FIG. 1. Actual production time per hour of key classes of equipment averages 44 min. Stop-watch studies made by Bureau of Public Roads show that small delays of a few seconds each add up to large time losses. Cost of minor delays runs high, since these delays come during periods of maximum operational expense.

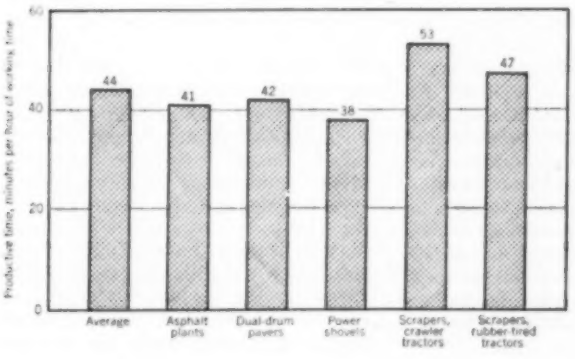
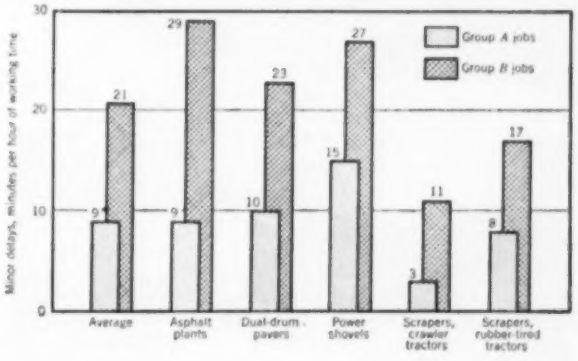
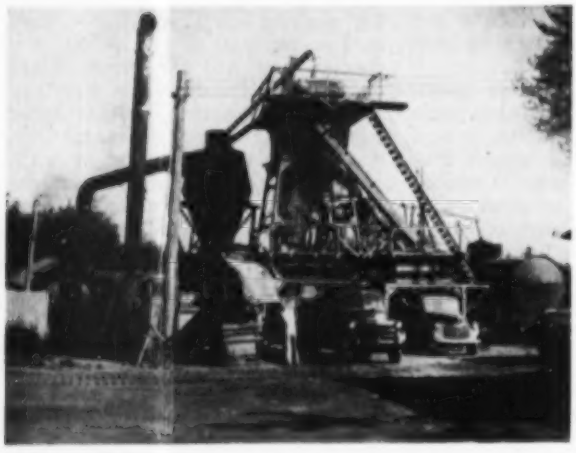


FIG. 2. Time lost through minor delays on five jobs with fewest delays per working hour (Group A), was compared with time lost on five jobs with most delays during working hours (Group B). Average difference of 12 min per hour is an indication of savings which can be achieved by careful operational planning.



Small time losses of less than 15 min are ordinarily figured as part of working time. Stop-watch studies have shown these small delays to total an average of 16 min each hour.

Difference of 12 min of minor delays per hour between two groups of power-shovel jobs was found to be largely attributable to hauling units. Of this difference, 6 min were lost because of short supply of hauling units and 3 min were lost in maneuvering hauling units into position.



Minor delays to asphalt plants range from 9 min per hour on some jobs to 29 min per hour on other jobs. Over half of this difference was found to be result of shortages of dried aggregate. Short supply of hauling units also made a major contribution to time losses.

Pusher units facilitate scraper loading. Shortage of pusher units was most frequent cause of minor delay to rubber-tired tractor-drawn scrapers. Lack of a pusher was of much less importance as cause of delay to crawler tractor-drawn scrapers because they can self-load under most conditions.

The 44-min hour

On the average, for the jobs studied, it has been found that key equipment actually produces for 44 min in each working hour. The remaining 16 min consist of minor delays (Fig. 1). For purposes of illustrating the range of minor delays experienced by each class of equipment, delays were summarized for two groups of jobs as follows:

Group A jobs: The 5 jobs with the fewest minor delays during working time

Group B jobs: The 5 jobs with the most minor delays during working time

Minor delays to asphalt plants range from 9 min per hour of working time on Group A jobs, to 29 min per hour on Group B jobs. At the other extreme are the crawler tractor-drawn scraper units, for which minor delays ranged from 3 to 11 min per hour on Group A and Group B jobs respectively. The average for the selected classes of equipment is 9 min for Group A and 21 min for Group B (Fig. 2).

Causes of delay studied

Conditions vary from job to job. Equipment may be new on one job, old on a second; available labor may be first rate on a third job, and totally inexperienced on a fourth; job terrain may be easy on the fifth job, and rugged on a sixth; and so on. In spite of such variables, there are certain causes of delay which tend to predominate in accounting for the major portions of the differences in time losses between Group A and Group B jobs. The general findings for each class of equipment are as follows:

Asphalt plants. Minor delays to asphalt plants range from 9 min to 29 min per working hour on Group A and Group B jobs respectively. Of the 20-min difference, over half is due to greater shortages of dried aggregate on the Group B jobs. These shortages are largely the result of insufficient dryer capacity. Many contractors modify original dryer equipment to overcome this bottleneck.

Most of the remaining difference is associated with hauling units. On Group B jobs there is 5.5 min more minor delay each hour due to a short supply of hauling units and 2.5 min

more delay due to greater exchange time required. Delays due to this latter cause are principally the result of the plant layout. On the Group B jobs, the layout was frequently such that a greater amount of time was required by the incoming hauling unit to complete its turning and backing maneuvers at the plant after the previously loaded unit was on its way.

Dual-drum pavers. For dual-drum pavers, minor delays amounted to 10 min per working hour on the Group A jobs and 23 min on the Group B jobs. The difference of 13 min is almost wholly due to the longer delays associated with batch trucks on the Group B jobs. One-half of the difference is caused by lack of a truck at the paver, and one-half by excessive dumping time. With respect to the latter item, batch-dumping practices vary widely. Within the cycle of operation of dual-drum pavers, the skip is on the ground from 15 to 25 sec, depending on the length of mixing time, the batch-meter setting, and other factors peculiar to each job. During this interval the truck must back onto the skip, dump its batch, and clear the skip.

On some jobs, where the drivers are properly coached, where the body of the waiting truck can be hoisted in readiness for dumping, and where a capable dumpman directs dumping operations, these batch-dumping maneuvers can be completed in 10 sec or less. On other jobs, where less attention is paid to batch dumping, as much as 30 sec may be required. In these latter cases, which are characteristic of Group B jobs, better supervision, control, and planning of the batch-dumping process will pay substantial dividends in increased paver production.

Power shovels. On Group A jobs, power shovels experience about 15 min of minor delays during each working hour; on Group B jobs the minor delays amount to 27 min each hour. About one-fourth of the 12-min difference is due to the fact that delays in all categories tend to increase somewhat on Group B jobs. The remaining 9 min of the difference are the result of greater delays which are associated directly with the hauling units—6 min due to short supply of hauling units and 3 min due to hauling-unit maneuvers and exchange time. Shovel delays due to this latter cause are largely the result of conditions at the shovel site, where a waiting hauling unit cannot complete its turning and backing maneuvers until the previously loaded unit is out of the way.

Crawler tractor-drawn scrapers. As a general class of equipment, crawler tractor-drawn scrapers experience the lowest minor delays—3 min per working hour on Group A jobs and 11 min per hour on Group B jobs. This class of equipment is also unique from the standpoint that there are no particular categories of minor delays which account for the major part of the difference of 8 min between the Group A and the Group B jobs. Minor mechanical adjustments, maintenance, and repair delays amounted to one-fourth of the difference, but the remainder was fairly well distributed among other types of delays.

Rubber-tired tractor-drawn scrapers. Minor delays to rubber-tired tractor-drawn scrapers range from 8 min per working hour on Group A jobs to 17 min per hour on Group B jobs. Of the 9-min difference, 7 min are due to the additional time of waiting for a pusher on the Group B jobs, and 2 min to the slight increases in other types of delays. For this class of equipment, a pusher (or puller) is an integral part of the loading operation. Studies on pusher operations reveal that assistance can be given on 24 scraper loadings per hour on the average by a single pusher. When required scraper loadings exceed this rate per pusher, or when the scrapers tend to bunch up in the cut area, delays will result.

Supply of hauling units

Almost without exception, the supply of hauling units is a focal point of potential difficulty on any job where hauling to or from the key equipment is an integral part of the production process. The problem involved is economic—that of maintaining the supply at amounts that will result in minimum overall cost of work performed. When haul conditions or distances vary throughout the day and from day to day, the solution to the problem is not easy. There may be, for example, several hours when there is a surplus of hauling units followed by several hours of short supply. Then, too, the tendency of hauling units to bunch up and thin out presents a constant problem. Unfortunately the surplus existing at any one time cannot be stored for use when a shortage occurs. Only rarely do circumstances permit the number of units to be varied in accordance with needs without incurring premium costs for such flexibility.

A certain amount of delay to both key equipment and hauling units in waiting for one another is characteristic of most jobs. On one group of jobs where key equipment (asphalt plants, dual-drum pavers, and power shovels) was delayed about 8 min each hour in waits for hauling units, each hauling unit was in turn delayed about 9 min an hour in waiting for the key equipment. On another group of jobs, the corresponding delays were 3 min for the key equipment and 14 min for each hauling unit. Thus in general, for the jobs studied, it may be stated that the sum of (1) the number of minutes per hour that key equipment waits for hauling units, and (2) the number of minutes per hour that each hauling unit waits for the key equipment, totals about 17. This empirical relationship varies on individual jobs and of course does not hold true where there are extremes of oversupply or undersupply of hauling units.

Minor delays—persistent small time losses of less than 15 min each—are grit in the gears of a highway construction job. They exist on all jobs and occur when going expenses are at a maximum. For key equipment, they absorb an average of 16 min out of every working hour. On some jobs nearly half of the working time is consumed by these small delays. The principal causes of trouble are the supply and operation of hauling units on jobs where the key equipment is an asphalt plant, a dual-drum paver, or a power shovel. In such cases, the problem of hauling-unit supply is critical inasmuch as any advantages gained by keeping supply delays to a minimum tend to be offset by increased time losses to the hauling units themselves. On scraper grading jobs, shortage of pusher units to assist in loading is a major source of delay to rubber-tired tractor-drawn scraper units.

Minor delays cannot be eliminated completely, but comparisons among jobs leave little doubt that they can be substantially reduced in many cases by competent job management. The contractor who recognizes the importance of small time losses and who does something about them will make more money. The highway-using public also stands to gain. Inevitably some of the savings made possible by greater efficiency in free competitive enterprise will be passed on in the form of lower bids on highway work.

Buford Dam—

Corps of Engineers

Buford Dam Project is a multiple-purpose development now under construction on the Chattahoochee River, 35 miles northeast of Atlanta, Ga., by the U. S. Army Corps of Engineers. The main features include a high earth dam, a power plant, three saddle dikes, and a chute spillway. Buford is one of the key projects in the development of the Apalachicola River system. For navigation the project will contribute toward a 9-ft depth from the Gulf of Mexico for a distance of about 270 miles to Columbus, Ga. Of particular interest is the arrangement of the powerhouse and its intakes.

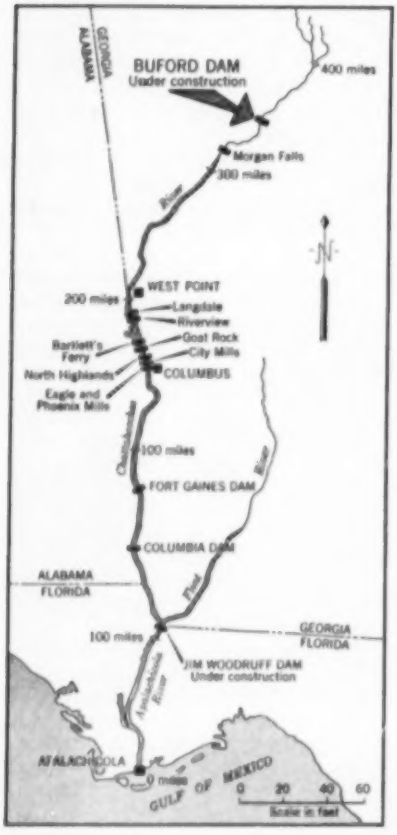


FIG. 1. **Buford Dam, under construction on Chattahoochee River 35 miles northeast of Atlanta, Ga., will store 1¼ million acre-ft of water for flood control, navigation, and 86,000 kw of hydro power.**

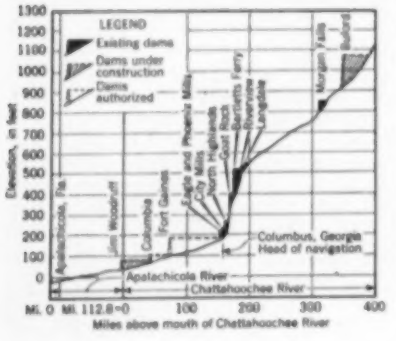


FIG. 2. **One of key projects being built by Corps of Engineers for control of Apalachicola River system is Buford Dam, furthest upstream of existing or projected developments. Other Corps of Engineers' Projects are Jim Woodruff, Columbia, and Fort Gaines. Existing dams are all in private hands.**

Since the first examination and survey of the Apalachicola River system in 1872, numerous studies contemplating improvement have been made. Early improvements were for navigation only. By periodic dredging, a 6-ft channel has been maintained on the Apalachicola River and a 4-ft channel on the Chattahoochee River as far as Columbus, Ga., considered the head of navigation (Fig. 1). The present navigation project, authorized by the River and Harbor Act of July 24, 1946, provides for a 9-ft channel from the Gulf of Mexico at Apalachicola, Fla., to Columbus, Ga., a distance of about 270 river miles. On the lower river this includes the Jim Woodruff Dam on the Apalachicola River, now under construction, and the Columbia and Fort Gaines Dams on the Chattahoochee River, which are in the planning stage. On the upper river it includes Buford Dam, now under construction.

Between Columbus, Ga., and the Buford Dam site, the Georgia Power Co. has in operation seven power dams with an aggregate capacity of nearly 110,000 kw. The relation of these plants to the Federal Government's river improvement projects is shown on the profile, Fig. 2.

The principal benefits which will accrue from the Buford Dam are an increased depth of channel below the Jim Woodruff Dam during the low-flow season; reduction of flood losses on profitable but low-lying agricultural lands along the river between the dam and West Point, Ga. (the downstream limit of effectiveness); generation of hydroelectric power (86,000 kw of installed capacity); assurance of an adequate water supply for the Atlanta area; and the provision of recreational areas.

The Buford Dam site was selected after a consideration of many plans for the comprehensive development of the entire Apalachicola River system. The topography and geology of the site permitted a wide latitude in the choice and arrangement of structures. Foundation rock was found to be satisfactory for the construction of either a masonry or an earth dam. Other features were also favorable for either type of dam. Rock for concrete aggregate and riprap was available in the immediate area as well as suitable material for an earth embankment. Conditions were such that either a fixed crest or a gated spillway could be chosen. For these reasons the selection of type of structure was based almost entirely on economic studies.

An earth dam with an unlined chute spillway proved to be more than six million dollars cheaper than a masonry dam. Estimates also favored a powerhouse and flood-control sluice on the right bank with short penstocks through the right abutment to realize a saving of another million dollars.

The principal features of the adopted plan (Fig. 3) are:

1. A rolled earth-fill dam supplemented by earth dikes across three low saddles, built to El. 1106 ft.
2. An unpaved chute spillway consisting of a 100-ft-wide cut with crest at El. 1085, located about one mile east of the dam.
3. A powerhouse in a deep rock cut adjacent to the dam on the right bank to contain two 40,000-kw units and one 6,000-kw unit.
4. Steel penstocks in tunnels through the right abutment.
5. A flood-control sluice paralleling the penstocks for emptying the flood storage volume.
6. A concrete intake structure at the upstream end of the tunnels provided with regulating gates and hoists.
7. Dead storage of 867,000 acre-ft below El. 1035; power storage of

builds multi-purpose structure near Atlanta, Ga.

CARL E. BENTZEL

Chief, Program Development Branch

Mobile District

U.S. Army Corps of Engineers

Mobile, Ala.

1,018,000 acre-ft between Els. 1035 and 1070; and flood storage of 610,000 acre-ft between Els. 1070 and 1085.

Excavation for powerhouse

Foundation explorations were concentrated in the areas allocated to forebay, intake, tunnels, powerhouse, and tailrace. The borings included a 36-in. hole in the vicinity of the intake and several vertical and inclined exploratory holes. The tunnels were constructed without mishap, dry and unshored, the rock being hard gneissic granite. The total volume of tunnel excavation was 13,617 cu yd. In addition, the large open cuts for forebay and tailrace involved the excavation of 907,000 cu yd of rock and 770,000 cu yd of common overburden excavation. The greatest depth of cut, 240 ft, is in the powerhouse area. In the forebay the greatest depth of cut is 180 ft.

On September 11, 1952, when excavation had been carried down to El. 1000, a major slide of 83,000 cu yd occurred on the west side of the tailrace. Later, on February 24, 1953, a minor slide of 6,300 cu yd occurred in the forebay area after the excavation had reached final grade at El. 890. Neither slide injured personnel or damaged construction equipment. No further slides are anticipated. A contract for excavation, including tunneling, was awarded to Groves, Lundin & Cox, Inc., on May 25, 1951. The work is now complete.

Spillway a mile from dam

Above the Buford site the drainage area of 1,046 sq miles is subject to an average annual rainfall of 59.5 in. A record flood of 55,000 cfs occurred in January 1946. Because the design and operation are based on putting flood waters into storage rather than passing them over the spillway, as in conventional projects, the natural peak discharge of the spillway design flood of 279,000 cfs will be reduced to an outflow of 28,100 cfs (spillway, 16,400 cfs; sluices, 11,700 cfs), giving almost complete regulation. The spillway chute, 100 ft wide, is unlined, with cut slopes in rock of 1 horizontal to 6 vertical. It is estimated that the spillway will discharge only about once in 500 years.

The spillway, now completed, was the first item of project work undertaken. On February 16, 1950, the contract, which included the adjacent dike, was awarded to H. N. Rodgers & Sons Co. The main items of construction were as follows:

Common excavation	200,000	cu yd at $0.22
Borrow	304,000	cu yd at 0.22
Rock excavation	144,000	cu yd at 0.75
Compacted fill	418,000	cu yd at 0.06
Total cost	$297,627	

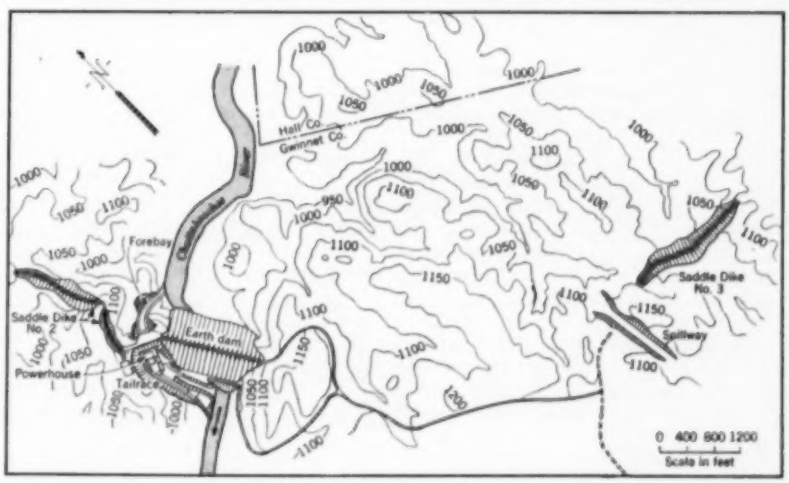
Rolled earth for main dam

The main dam, of rolled-fill construction, will have a sizable upstream rock section. With the crest at El. 1106, the maximum height will be about 200 ft. The crest will be 1,630 ft long and 40 ft wide to provide a roadway. Side slopes will be $2^1/_2$:1. Including backfill behind the intake structure and core trench excavation, the structure will be composed of about 5,000,000 cu yd of earth and rock. A typical section through the dam and powerhouse is shown in Fig. 4.

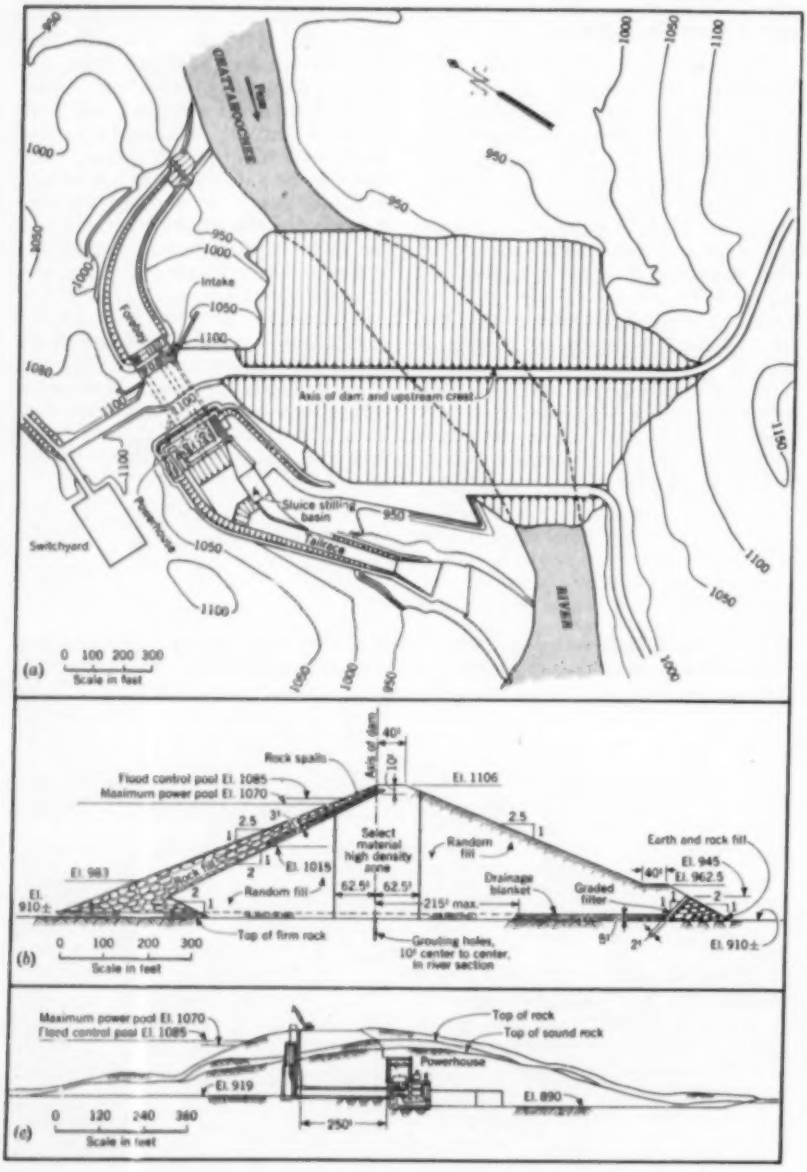
Control gates, one gate for each penstock, will be of tractor type, 17 ft wide by 28 ft high, fabricated from structural shapes by welding, and operating on roller tracks. A gate can be closed in 5 min. The intake structure will be concrete, 141 ft wide by 195 ft high, with base elevation at 911 ft. In the lower part of the intake structure, the concrete will be poured against the rock excavation. Above the rock, the intake structure and flanking wing walls will retain the fill for the earth abutment of the dam.

Two Broome gates, 6.5 ft wide by 13.24 ft high, will control the sluice entrance. They are designed to be closed or opened at any pool level for the control of floods. In March 1953 the contract for the sluice gates was let to Phillips & Davies, Inc.; that for the head gates, stop logs, and trash racks to Guy F. Atkinson Co. and Willamette Iron & Steel Co.; and that for the gate joists, to Armstrong & Hand, Inc. A contract for construction of the intake structure and the sluice stilling basin, and for installation of the fabricated parts, was let in October 1953 to J. A. Jones Construction Co. By June 15, 1954, the installation is to be completed to El. 978 so that the contractor on the main dam can block the river and divert it through the penstocks and sluice conduit. Contracts for the intake structure and sluice stilling basin totaled $2,019,598.

FIG. 3. **Besides main earth dam, Buford Project requires three rolled-fill saddle dikes (now completed) and considerable excavation for spillway and for powerhouse forebay and tailrace.**



Besides Buford Dam, earth-fill structure 200 ft high and 1,630 ft long, project includes three earth-fill saddle dikes, spillway one mile from main dam, and powerhouse at main dam.



Penstocks and flood control conduit

Between the intake structure and the center line of the two main power turbines in the powerhouse, the distance is 365 ft. Of this, 246 ft is in tunnel, lined with welded steel-plate pipe to a completed diameter of 22 ft. Between the steel and the tunnel wall, concrete has been placed and grouted. The steel lining is designed to take the full internal water pressure, including water hammer. The penstock for the small turbine is of 10-ft diameter, steel lined. This penstock branches off from Unit No. 2 penstock.

The flood-control sluice tunnel will have a concrete-lined diameter of 13.25 ft. Because of relatively low interior pressures, no steel lining or pressure grouting of the concrete will be required, except at the transition and to provide an overlap with the grouting from the cutoff trench above.

A contract for the construction of the conduits was awarded in March 1953 to L. A. Tuedt, contractor, for $517,486.

Powerhouse designed for 86,000 kw

Except for its unique location in a deep rock cut, the powerhouse is of conventional design. It will house three turbines—two of 55,000-hp, vertical shaft, driving 40,000-kw generators, and one of 8,400 hp, driving a 6,000-kw generator. The dependable capacity of the plant at full gate and minimum head will be 73,000 kw, and the average annual output will be 162,000,000 kwhr.

Contracts have been let as follows: for the large turbines, to Newport News Shipbuilding and Dry Dock Co.; for the small turbine and the butterfly valve in the small penstock, to James Leffel and Co.; and for the generators, to Westinghouse Electric Corp.

The design and contract drawings for the powerhouse were prepared under contract by Erik Floor and Associates, Inc., Chicago, Ill.

(This article is based on the paper read by Mr. Bentzel at the Atlanta Convention, before the Structural Division session presided over by George Brandow, a member of the Division's Executive Committee.)

FIG. 4. Buford Dam, seen in plan in (*a*) and in cross section in (*b*), is earth-fill structure 200 ft high and 1,630 ft long, with rock fill for upstream face and downstream toe. Besides tailrace serving two main power turbines (*c*), special sluiceway is provided for direct reservoir discharge, since spillway is designed for rare overflow, perhaps once in 500 years.

(Vol. p. 166)

Buford Dam—

Features of chief construction interest

Compaction procedures and heavy rock excavation

CHARLES A. JACKSON, JR., Resident Engineer, Buford Dam Project, U.S. Corps of Engineers, Mobile District, Ala.

Compaction procedures for the rolled-fill saddle dikes and the main dam, and the long-hole method of excavation for the tunnels connecting forebay and tailrace, are probably the chief features of construction interest encountered on the Buford project so far.

Several different compaction procedures were studied and compared during the construction of the first rolled-fill saddle dike to be built, No. 3, completed in 1951. The results of these studies, as will be described, were used in determining the compaction method to be used for the other two saddle dikes, completed in 1953, and the main dam, the contract for which was recently awarded.

The saddle dikes required to impound Buford Reservoir were built up to El. 1106, the elevation of the top of the main dam. The three dikes have a total length of 6,594 ft and a maximum height of 70 ft. The reservoir will extend 46 miles up the Chattahoochee River and 20 miles up the Chestatee. At the top of the flood control pool, El. 1085 ft, the reservoir surface will have an area of 46,000 acres.

Saddle Dike No. 3, the first project work to be constructed, contains 420,000 cu yd of fill excavated from the adjacent spillway cut, supplemented by material from borrow pits. Saddle Dike No. 2 contains 163,000 cu yd of fill, and Saddle Dike No. 1, 180,000 cu yd of fill. Both are on the right bank of the river and begin at the main dam. They were constructed by utilizing material excavated from the nearby forebay and tailrace.

The fill material for Saddle Dike No. 3 was spread in 9-in. horizontal layers and compacted with a sheepsfoot tamping roller. The tamper feet of the roller had a clear projection of 7 to 9 in. from the roller's cylindrical surface and a face area of 5 to 7 sq in. The roller was loaded to develop a pressure of 400 psi. Six passes were required to obtain the desired compaction, with the material within a working range of plus or minus 2 percent of optimum moisture.

Test-fill studies were included in the construction of this saddle dike to determine the compaction characteristics of the borrow materials, using different types of rollers, variations in moisture, and thickness of layers being compacted.

A sheepsfoot tamping roller of the design previously described was modified by welding a 3-in. × 4-in. steel plate to each tamping foot to increase its area to 12 sq in. This roller was loaded to develop a pressure of about 200 psi.

The other roller tested was a four-wheel rubber-tired roller with the wheels mounted on two separate axles, located in a line, to provide for uneven ground. This roller was loaded to 19,500 lb per wheel with 65 psi of air pressure in the tires.

The moisture content of the test-fill material was varied within a range of plus or minus 4 percent of optimum. The thickness of layers before compaction was varied from 9 to 18 in. It was found that substantially the same compaction was obtained by using any one of three procedures: (1) a 9-in. layer within a range of plus or minus 2 percent of optimum moisture with six passes of the standard roller; (2) a 12-in. layer within a range of plus or minus 2 percent of optimum moisture with six passes of the modified roller; or (3) a 15-in. layer within a range of minus 4 percent up to optimum moisture with four passes of the rubber-tired roller.

The results of these studies were used in determining the method of compaction for the main earth dam and for Saddle Dikes Nos. 1 and 2. The specifications for construction of these saddle dikes gave the contractor his option of using either one of the three rollers described above. He started operations with the modified roller, but found that the standard roller offered more maneuverability in the comparatively narrow work area.

Forebay and tailrace excavated

The forebay and tailrace at the right abutment were excavated in two stages. Stage 1 consisted of excavating 771,120 cu yd of unclassified material lying above firm rock. This was excavated and hauled by 12-cu yd tractor-drawn scrapers, and 2-cu yd power shovels loading into 10-cu yd bottom-dump trucks. Stage 2 consisted of 900,500 cu yd of rock excavation. The rock was drilled with wagon drills, holes 15 ft deep being spaced on approximately 6-ft centers. Approximately $1^1/_4$ lb of powder per cu yd was used in blasting. Shovels of 2-cu yd capacity loaded the excavated material into end-dump trucks holding 15 cu yd. Vertical faces against which concrete was to be placed later, to form the intake structure and powerhouse, were line drilled with quarry bars, the holes being spaced on 5-in. centers. A total of 71,280 sq ft of face was drilled in this manner.

Long-hole method used in tunnels

Three tunnels connect the forebay and tailrace, each 246 ft long. Two are penstock tunnels with driven diameters of 26 ft, and one is a sluice tunnel with a driven diameter of $16^1/_4$ ft. A branch tunnel to serve a small power unit diverges from Penstock Tunnel No. 2 at a point 100 ft from the downstream end. This branch tunnel has been cut to a diameter of 13 ft 8 in. The tunnels were driven after completion of the forebay excavation but prior to completion of the powerhouse excavation; therefore the tunnels were "daylighted" at the downstream end during the excavation for the powerhouse.

Forebay for Buford Powerhouse was excavated in rock to length of 850 ft and width varying from 50 ft at entrance to 140 ft at intake structure, and depth of 180 ft at entrance to penstock tunnels.

Penstock Tunnels Nos. 1 and 2 were excavated by driving 14 × 14-ft pilot tunnels on the center line and at the bottom of the finished tunnels. These pilot tunnels were driven full face with a drilling jumbo on a half track, mounting four water drifters. Drill holes 7 ft deep resulted in a pull of about 6½ ft, using about 3 lb of powder per cu yd. A diesel rocker-shovel loaded muck into Dumpsters for removal from the tunnels.

After completion of the pilot tunnels in Penstocks Nos. 1 and 2, slots 10 ft long were mined out to finished diameter by stoping methods. These slots were spaced 90 ft apart, with the first slot located at the downstream end of the transition between the intake and the circular tunnel, or approximately 34 ft from the upstream face. Scaffolds were then erected in these slots and diamond-drill holes of 1½-in. diameter were drilled approximately 40 ft long and spaced 5 ft apart around the circumference of the tunnels, with four relief holes forming a triangular pattern, two on the center line 4½ and 8½ ft above the pilot tunnel, and one 5 ft each side of the center line 4½ ft above the pilot tunnel.

All the long holes downstream of the transition section were loaded full for simultaneous blasting. The four relief holes were blasted first and the material mucked out; then the other loaded holes were blasted at one time. The broken rock filled the tunnels to within approximately 8 ft of the top, so that scaling, trimming, and washing could be accomplished from the top of the muck. After removal of this material, the long holes in the transition section were loaded and blasted.

The sluice tunnel and Penstock No. 3 tunnel were driven with "full-face" headings, by the same jumbo and hauling units used for Penstocks Nos. 1 and 2.

Tunnels were driven by Gates & Fox Co. of Salt Lake City, Utah, subcontractor under Groves, Lundin & Cox of Minneapolis.

Penstocks 1 and 2 are being lined to a finished inside diameter of 22 ft with steel plates backed up with concrete. Penstock 3 is being similarly lined to a 10-ft finished diameter. The sluice tunnel is lined with reinforced concrete to a 13¼-ft finished diameter.

Steel for the penstock linings was fabricated at the mill and shipped to the site for assembly. It was assembled in 27-ft sections in the tailrace area and pulled into place in the tunnel on a small car by winch. All longitudinal seams and girth seams for the 27-ft sections were welded with an automatic welding machine while the stiffener angles and tunnel girth seams were hand welded.

The concrete in the tunnel linings was placed by the Pumpcrete method. Contact grouting was performed between the rock and the concrete and between the steel lining and the concrete, approximately 30 days after the concrete was placed, to fill any voids caused by concrete shrinkage.

Construction on the intake structure and sluice outlet works was started in December 1953. This work consists of placing approximately 70,000 cu yd of reinforced concrete in the intake structure, sluice block, and sluice stilling basin, and the installation of the sluice gates, head gates, trash racks, stop-logs, and hoists.

Rock excavation from forebay and tailrace is stockpiled for later use in upstream face and downstream toe of earth-fill dam.

Contract for main earth dam awarded

A contract amounting to $1,763,064 was awarded in February 1954 to J. W. Moorman & Son, of Belton, Tex., for construction of the main earth dam. The major items of work to be performed are: 500 acres of clearing and grubbing; 184,000 cu yd of unclassified excavation; 50,000 cu yd of filter blanket; 12,500 lin ft of grout-hole drilling; 6,000 cu ft of grout; 2,500,000 cu yd of compacted random fill; 1,225,000 cu yd of compacted select fill; and 560,000 cu yd of rock fill.

The earth fill will be obtained from a borrow-pit area on the left bank, a short distance upstream from the dam. The rock was obtained from the forebay, tailrace, and tunnel excavation. A portion has already been placed in the toe of the dam to furnish drainage and serve as a parking area. The remainder of the rock has been stockpiled upstream from the dam.

When the intake structure has been carried to a degree of completion that will permit diversion through the tunnels, the cofferdams in the forebay and tailrace will be removed and the river will be closed by earth and rock dikes at the upstream and downstream toes of the dam. The area between will then be unwatered, cleared, and grubbed; the core trench will be excavated; and the foundation rock grouted. Thereafter the dam will be constructed at a rapid rate with the aim of reaching El. 983 by December 1, 1954, and completion by July 1956.

The specified compactive effort for the core section will require 12 passes of a standard sheepsfoot roller, similar to the one described previously, using, 8-in. layers; or six passes of a rubber-tired roller with a wheel load of 25,000 lb and a tire pressure of 80 to 100 lb per sq in., using 12-in. layers.

The remainder of the earth portion of the dam will be placed and rolled in similar fashion except that only six passes of the sheepsfoot roller, using 10-in. layers, or three passes of the rubber-tired roller, using 18-in. layers, are specified.

Powerhouse to be completed in 1957

When the dam reaches El. 1030 in the spring of 1956, construction on the powerhouse will begin, and diversion will be through the sluice tunnel only. A cofferdam placed across the tailrace downstream from the powerhouse will protect the powerhouse area from flooding. Construction material and equipment will be transported to the powerhouse by an access road over the downstream berm of the dam.

View looking downstream from top of penstock tunnels shows rock excavation for tailrace at right and for flood-control sluice at left. Powerhouse will be constructed in immediate foreground after earth dam, at far left, has reached safe storage height.

The powerhouse will be of mass and reinforced concrete. About 38,000 cu yd of concrete will be required. Equipment will be installed in the switchyard, located on the top of the hill northwest of the powerhouse, concurrently with construction of the powerhouse. It is expected that the first power unit will go on the line in December 1957, and that final completion of the project will be in June 1958. The completion dates are contingent on the amounts of congressional appropriations.

(This article has been prepared from the paper presented by Mr. Jackson at ASCE's Atlanta Convention, before the Construction Division session presided over by Harold W. Hunt, secretary of the Division's Executive Committee.)

Penstock tunnels, 26 ft in diameter and 246 ft long, were excavated by advancing 14- by 14-ft pilot drift from which slots 90 ft apart were stoped out to full tunnel section. From these slots, long diamond drill holes were drilled and shot to pull full tunnel section. Here rock shovel in drift loads muck.

FIELD HINTS

Sloping-sill sand screens exclude silt from Egyptian irrigation canals

SERGE LELIAVSKY, M. ASCE, Civil and Hydraulic Engineer, Maadi, Cairo, Egypt

In Egypt the equivalent of millions of dollars is spent annually to remove silt from irrigation canals diverting water from the Nile River. Methods of reducing the annual cost of keeping canals in operation are always engaging the attention of irrigation engineers here as well as elsewhere.

The sand-screen design described in this article has proved particularly satisfactory in excluding silt from canals in Egypt. The savings obtained in some canals in one year exceeded ten times the cost of the weir. In the six-year period, 1943–1949, four weirs, discharging 20 to 100 cu meters per sec, saved annually about L.E. 10,000. (The Egyptian pound was recently quoted at U. S. $2.87.)

The design has been derived from the observed correlation between the radius of curvature of the water filaments at the diversion and the "angle of twist" or deflection angle between the direction of flow in the main canal and that in the lateral. It is based on a principle discovered by engineer Abdel Azim Ismail, Under Secretary of State for Public Works, Egypt, who observed the local asymmetry in the flow pattern at the intake of lateral canals.

The main parameter of this asymmetry, that is, the angle of twist, is a measure of the intensity of the centrifugal force which produces the helicoidal type of flow in the parent channel in the zone of influence of the diversion. The result is that low and heavily silt-laden filaments of water rise to the surface over the top of the sand screen, and deposit their load of silt in the lateral canal.

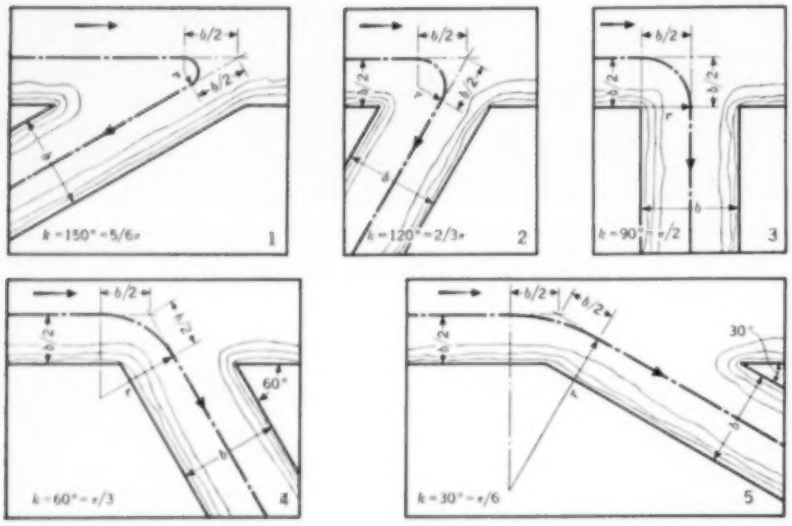


FIG. 1. Direction of flow as observed in nature and supplemented by scale models is here plotted for various "angles of twist" or deflection angles. These patterns form basis for approximate formula of centrifugal force, $r = b/2 \tan\left(\frac{\pi - k}{2}\right)$. For k = 30, 60 and 90 deg, flow lines are well defined.

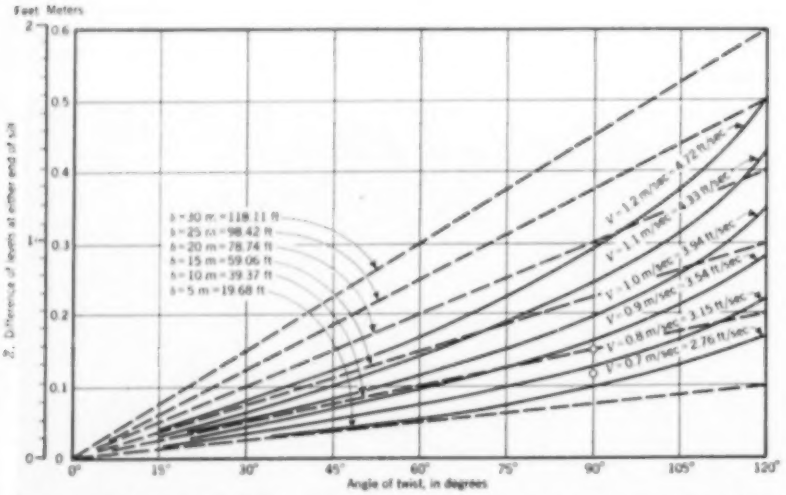

Feet Meters
Z, Difference of levels at either end of sill
Angle of twist, in degrees
0°
15°
30°
45°
60°
75°
90°
105°
120°
b = 30 m = 118.11 ft
b = 25 m = 98.42 ft
b = 20 m = 78.74 ft
b = 15 m = 59.06 ft
b = 10 m = 39.37 ft
b = 5 m = 19.68 ft
V = 1.2 m/sec = 4.72 ft/sec
V = 1.1 m/sec = 4.33 ft/sec
V = 1.0 m/sec = 3.94 ft/sec
V = 0.9 m/sec = 3.54 ft/sec
V = 0.8 m/sec = 3.15 ft/sec
V = 0.7 m/sec = 2.76 ft/sec

FIG. 2. Solid lines give difference in elevation between ends of sill for various widths of diversion canal and angle of twist, based on Eq. 3. Dotted lines show same differences based on empirical Eq. 4, derived from slope of scour holes.

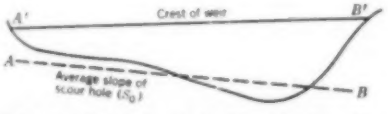


FIG. 3. Crest of weir is sloped in direction opposite to that of scour hole so as to impede velocity at B and force greater flow at A, thus eliminating scour effect.

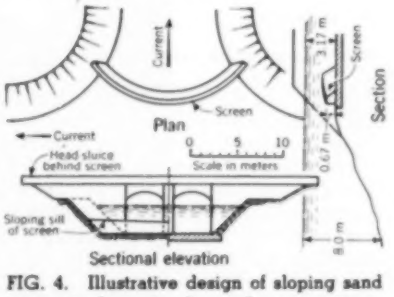


FIG. 4. Illustrative design of sloping sand screen is shown in plan and cross sections. Solution is given in text.

To counterbalance this detrimental effect, the sill of the sand screen, instead of being made level as in traditional designs, is sloped upward in a downstream direction, the slope being approximately equal in magnitude and parallel to the slope of the vortex. The hydraulic slope of the centrifugal flow is thus neutralized by the effect of the slope of the sill. Experience, theory, and experiments all have been mobilized to express this general principle in a formula.

In addition to observations made in nature, on actual irrigation works, of which there are thousands in Egypt, the direction of flow at diversions can also be traced by sawdust particles on scale models in a laboratory. A number of approximate patterns prepared from these various sources have been reduced to the diagrams shown in Fig. 1. From these, by trial and error, came the empirical formula,

$$r = \frac{b}{2} \tan \frac{\pi - k}{2} \quad . \quad . \quad . \quad (1)$$

in which

r = average radius of curvature of water filaments at diversion
b = width of lateral canal (diversion)
k = angle of twist (deflection angle)

While many engineers could produce a different empirical formula from the one here proposed, the writer is fairly certain that a majority of them would agree that there is a relationship between r and k.

As the formula stands, it is independent (within certain limits, of course) of the ratio between the width of the lateral and the width of the parent channel. Using a principle successfully employed by Grashof for the calculation of the transverse slope of the Rhine River, we can assume that the water surface is normal to the resultant R of the weight W and the centrifugal force, WV^2/gr, and thus obtain an approximate formula for the average transverse slope of the water surface, that is:

$$S = \frac{dz}{dx} = \frac{V^2}{gr} = \frac{2\,V^2}{bg \tan\left(\frac{\pi - k}{2}\right)} = \frac{2\,V^2}{bg} \tan \frac{k}{2} \quad . \quad . \quad (2)$$

For laying out work in the field, the difference between the sill elevations at each end of the sand screens is the desired dimension, Z. A practical approximation for Z was obtained by multiplying the average water-surface slope S by the width of the lateral canal b, from which

$$Z = \frac{2\,V^2}{g} \tan \frac{k}{2} \quad . \quad . \quad . \quad (3)$$

Equation 3 is represented graphically in Fig. 2 by the solid curves.

Also in Fig. 2, the dotted curves represent the empirical approach derived by engineer Abdel Azim Ismail from the slope of the asymmetrical scour holes, S_0. A line connecting the mean bed level between A and B in Fig. 3 gives a slope which can be expressed in terms of the angle of twist as follows:

$$S_0 = k/50\,\pi \quad . \quad . \quad . \quad . \quad (4)$$

In order to neutralize the vortex action, the crest of the weir was given a reversed slope $A'B'$ so that the velocity at B' was impeded and flow encouraged at A'.

The values of S_0 given by Eq. 4 are the average slopes of the scour holes. The slope of the weir is to be made equal in value and opposite in direction. Multiplying the values of S_0 obtained from this equation by b, we obtain the empirical values for Z, which are shown in Fig. 2 by dotted lines.

Sloping-sill sand screen is seen under construction on Abbasi Canal, which serves 200,000 acres in Lower Egypt.

In this tentative arrangement, two sand screens are used, one a closed inner sloping weir, the other an outer weir with an open throat on the downstream side (foreground). This experiment is still in progress. Other alternative types of screens are under investigation.

The rather remarkable fact is that the two methods here presented, although based on different physical facts—one on the vortex theory, the other on the slope of the scour holes—nevertheless yield reasonably consistent results.

The agreement between these curves is close for lower values, and the reasons for the differences at higher values are still being investigated. Until more is known on the subject, the average of the results from the two methods may possibly be used. Experiments are still under way.

Typical example solved

Take for a typical example, a diversion canal leaving the parent channel at 90 deg, and having the following metric dimensions: Bed width, $b = 10$ m; depth, $y = 3.17$ m; slope $S = 12$ cm per kilometer, from which the discharge $Q = 32$ cu m per sec, and $V = 0.76$ m per sec.

Enter the diagram, Fig. 2, to find the theoretical $Z = 0.12$ cm and the empirical $Z = 0.15$ cm. Average $Z = 0.135$ cm ($5^1/_2$ in.). See circled points in Fig. 2.

The depth of the water in the parent canal is 8.0 m. It is desirable to design the diversion so that the sheet of water over the sill will be from one-

quarter to one-third of the water depth in the parent channel, and the velocity over the sill will be about that in the diversion canal.

Design for a velocity over the sand screen of 0.8 m per sec, and a length of screen of 16 m, as shown in Fig. 4. Make the average height of the screen 0.67 m above the bottom of the diversion canal—actually 0.60 m upstream and 0.73 m downstream. The sill may be made sloping, or for easier construction, it may be divided into eight horizontal steps each 2 m long and about 2 cm high.

The diagrams and curves are applicable also to adjustable sand screens of the flashboard type, which are used to alter the slope to meet seasonal changes in velocity and water level.

ENGINEERS' NOTEBOOK

Nomographs for rapid design of bearing plates

I-T'AN YU — Designer, Kuljian Corporation, Philadelphia, Pa.

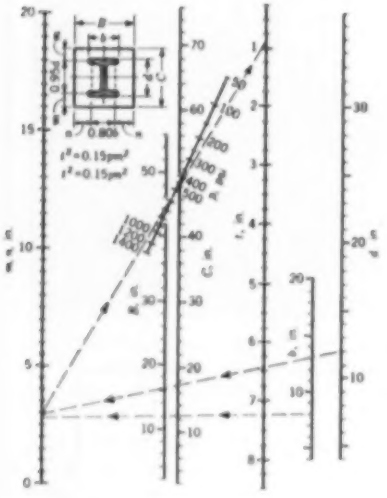


FIG. 1. Nomograph for designing column base or beam bearing plate is based on allowable stress in base of $F_b = 20$ kips per sq in. For different values of F_b, use $t = t_0 (20/F_b)^{1/2}$, where t_0 = thickness obtained from above nomograph. For example, if $F_b = 1.33 \times 20$ kips per sq in., use $t = 0.866\ t_0$.

TABLE I. Results for Example 1 are entered in convenient form

Beam & Size	R (kips)	A (sq. in.)	C (in.)	B (in.)	k (in.)	$n = \frac{B}{2} - k$	p (psi)	t (in.)
B 201 16WF50	45	180	12	15	1.125	6.375	250	1 3/4

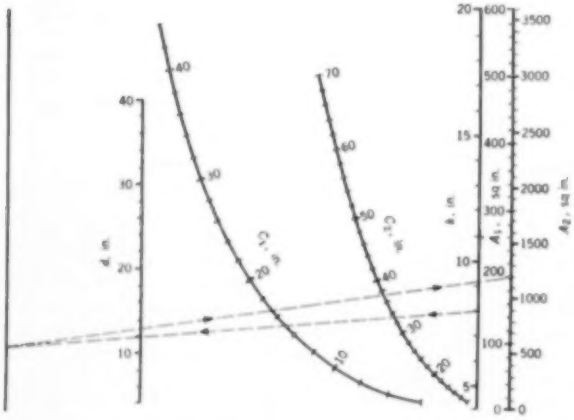


FIG. 2. Nomograph speeds finding of economical dimensions, C and B, for column base plates. To determine thickness, t, use this nomograph in conjunction with Fig. 1.

TABLE II. Results for Example 3 are entered systematically

Col. & Size	R (kips)	b (in.)	d (in.)	A (sq. in.)	C (in.)	B (in.)	p (psi)	t (in.)
C1 12WF40	120	8	12	200	17	12	588	7/8

When a great number of column base plates or beam bearing plates are to be designed, it is convenient, accurate, and time-saving to use nomographs. Those shown here are based on the formulas given in the *Steel Construction Manual* of the American Institute of Steel Construction.

Example 1

A beam of 16WF50 has an end reaction, R, of 45 kips where it rests on a masonry wall. The wall thickness allows a maximum length of 12-in. bearing for the beam. Allowable bearing pressure is 250 psi. Design a bearing plate.

Solution:

Area required, $A = 45{,}000/250 = 180$ sq. in. Use $C = 12$ in. and $B = 180/12 = 15$ in. For 16WF50, $k = 1.125$ in. Then $n = 15/2 - 1.125 = 6.375$ in.

Use of nomograph:

On the nomograph, Fig. 1, draw a line from $n = 6.375$ on the n-scale through $p = 250$ on the p-scale and

prolong to intersect on the t-scale. Read $t = 1^1/_4$ in. Calculations and results can be entered on a convenient form, such as that shown in Table I.

Example 2

Column 12WF40 of 120-kip reaction is to rest on concrete pier of 600-psi allowable bearing pressure. Minimum length of bearing plate is to be 20 in. because of detail limitation, use $C = 20$, $B = 200/20 = 10$ in.

Use of nomograph:

(*a*) On Fig. 1 join a line through $d = 12$ and $C = 20$ on corresponding scales and extend to intersect on m-scale.

(*b*) Also on Fig. 1, join a line through $b = 8$ and $B = 10$ on corresponding scales and extend to intersect on n-scale.

(*c*) Join the higher point obtained from above with $p = 600$ on the p-scale with a line and extend to intersect the t-scale. Read $t = 1\ ^5/_{16}$.

Example 3

Design an economical base plate for the same column as in Example 2 with no limitations to the dimensions required.

Solution:

Use nomograph, Fig. 2, for economical column base plate:

(*a*) On Fig. 2, join a line through $b = 8$ and $d = 12$ on b- and d-scales and extend to intersect the vertical line to the extreme left side of the graph.

(*b*) Join the intercept determined in step (*a*) with a straight line to $A = 200$ on the A_1 scale. Read the point of intersection on the C_1 scale as $C = 17$ in. Then $B = A/C = 200/17 = 11.75$, say 12 in.

(*c*) Use $C = 17$ in. and $B = 12$ in. and follow through the same method as in Example 2 on Fig. 1 to determine $t = 7/8$ in. The results are then entered in Table II.

Lines shown with arrow heads on the nomographs illustrate all steps for Example 3. Note the closeness of the m and n values.

Using these nomographs, the writer has been able to design column base plates at the rate of about 2 minutes per plate.

THE READERS WRITE

Improving public relations— The engineer can do it himself!

To the Editor: Winston Churchill said, "Never did so many owe so much to so few." If he had been speaking of engineers he could have said, "Never did so many owe so much to so few and know so little about them."

How many times have your friends expressed interest in what you do! There is your cue, your opportunity to spread understanding of what the engineer does in terms the hearer can easily grasp. For example, you might say:

"I figure out short-cuts through town. Why, do you realize that the Healdsbury Avenue Extension saves every car using it 35 seconds? This, for 50 cars using it per minute, means 350 man-hours saved every day. That is a little more time than it takes American industry to make an automobile. My work saves men's time. My work and that of all the other engineers is the reason why you work 8 hours a day 5 days a week while your grandfather worked 12 hours a day 6 days a week."

Figure out the time and other meanings of engineering works of universal interest in advance. Just what does the Golden Gate Bridge mean to California? Have the facts ready for your opportunity—on paved roads, railroads, hydro plants, flood control, for example.

All this boils down to three points:

1. Tell the story of engineering.
2. Tell it with familiar words and expressions.
3. Turn engineering works into their time-saving meaning, the essence of their worth.

If you have a boy who builds things in his head, and is not sure what he wants to be, introduce him to an engineer. The United States needs engineers. We are 300,000 short now. The Russians are turning them out at the rate of 40,000 a year. They know what a "time merchant" is. They know that there is a "fountain of youth." Hot war or cold, the "time merchants" are on the front line. The stop-watch is mightier than the atom bomb.

Francis G. Yates, A.M. ASCE
Office Engineer,
City Engineer's Office
Santa Rosa, Calif.

New book tells story of noted American engineer in Brazil

To the Editor: The new book, *Billings and Water Power in Brazil*, just published jointly by the author and the American Society of Civil Engineers, is well worth reading. In it Adolf J. Ackerman, M. ASCE, has told the very interesting story of Asa W. K. Billings and his extraordinary hydroelectric projects in Brazil—a worthy book about a worthwhile engineer. Billings was a great water-power pioneer in Brazil, and Ackerman, his associate, has related the history of these projects in an entertaining fashion, and with much modesty as regards his own part in the work.

I first met Billings in New York at the ASCE Annual Meeting January 15, 1947, where and when we were both inducted into Honorary Membership in ASCE. My wife and the charming Mrs. Billings were so congenial that we were invited to visit them in São Paulo. This we did in 1949. Thus I was personally shown over the great hydroelectric power project and rode up the steep inclined railway which parallels the five penstocks shown on page 67 (of Mr. Ackerman's book) leading to the Cubatao power station between Santos at the level of the Atlantic Ocean and São Paulo, 728 meters above, on "the Serra" plateau escarpment.

We could not help being greatly impressed with the bold conception of the whole program—the grouped reservoirs, the control dams and pumping stations which reversed the direction of flowing rivers, and the magnitude of the scheme. Then after a luncheon with prominent Brazilian officials and other visitors at the Serra guest house, all of whom extrolled the widespread benefits of this magnificent conception, we could not help but realize the abilities and vision of the outstanding engineer, Asa Billings.

Doubtless I was only one of several who suggested that this Rio Grande reservoir be called "Lake Billings," which was officially done May 12, 1949. Like Lake Meade behind our Hoover Dam, nothing could have been more appropriate than this practical recognition of, and memorial to, an outstanding international engineer.

Mr. Ackerman clearly shows how this large hydroelectric enterprise has enabled São Paulo to grow by leaps and bounds into one of the largest modern cities of the Americas. He has presented a most realistic and inspiring book of 127 large pages describing the vision and achievements of a really inspired engineer. The text is highly readable and the illustrations are excellent. I commend the author and recommend his fine book. It is a most welcome and valuable addition to my library—a fine Society publication.

A. P. Greensfelder, Hon. M. ASCE
Consulting Constructor
St. Louis, Mo.

SOCIETY NEWS

Ballot on Dues Increase Authorized at Atlanta Convention of Society

A constitutional amendment increasing Society dues will be voted on this spring as a result of action taken at the ASCE Atlanta Convention, to which the Georgia Section was host, February 17–19. With the unanimous vote of members attending a general business meeting of the Society, called on Wednesday, February 17, for the specific purpose of considering a dues increase, the ballots for necessary amendment of the constitution will go out to the membership in May.

The action at Atlanta was taken as a result of petitions received earlier from 200 or more members in each of the four Zones asking for amendment of Article IV, Section 2 of the constitution to permit increase of annual dues to $25 for Members, Associate Members, and Affiliates, and to $15 for Junior Members. The proposed dues would apply to all members, regardless of residence.

Welcoming Session and Luncheon

Following the brief business meeting on Wednesday morning, there was a half-hour "Welcoming Session." Section President C. E. Drummond and the Hon. William B. Hartsfield, mayor of Atlanta, brought warm greetings from the Section and the city, to which ASCE President Daniel V. Terrell responded suitably.

The prominent part played by engineers in the economic rebirth of the South was extolled by the Hon. Herman E. Talmadge, governor of Georgia, in the featured talk at the Wednesday "Welcoming Luncheon." Speaking on "Engineers and Their Public Responsibility," Governor Talmadge referred to the "commanding role played by the Society for 101 years in the building and development of the nation." Locally, he mentioned the 13,000 miles of highway construction let to contract in the state since 1948; the present expressway system under construction in Atlanta; the huge Savannah port development program now in its initial stages; and many other engineering works under way or recently completed in the state. An audience of over 500 heard Governor Talmadge, who was introduced by Blake R. Van Leer, president of Georgia Institute of Technology. The invocation was pronounced by the Very Rev. Alfred Hardman, Dean of the Cathedral of St. Philips. Dean Hardman graduated in engineering and practiced that profes-

Featured speaker at the Wednesday luncheon was Gov. Herman E. Talmadge (immediately above), who applauded the contributions of the profession to civilization. Governor Talmadge was introduced by Blake R. Van Leer, president of Georgia Tech (top photo).

Top brass at the Wednesday "Welcoming Session" is pictured in lower left view. Shown, in usual order, are President Terrell, Mayor William B. Hartsfield, Section President C. E. Drummond, and Moses E. Cox, general Convention chairman. In lower right photo Carl E. Beam (center), who retired from the ASCE staff last month, displays a Board resolution commending him for long service in key administrative and publication positions. With Mr. Beam are President Terrell and Executive Secretary Carey.

sion—one more evidence of the versatility of engineers.

Committee on Conditions of Practice Meets

Another innovation of the Wednesday morning program was a two-hour general session of the Committee on Conditions of Practice, which was established last year to coordinate all the Society's professional activities. ASCE Vice-President G. Brooks Earnest, chairman of the Committee on Conditions of Practice and presiding official, outlined the development and objectives of the committee. Others in the panel of speakers were L. E. Grinter, president of the American Society for Engineering Education, who reported on engineering education; Alan G. Stanford, past-president of the National Council of State Boards of Engineering Examiners, who discussed engineering registration; and James I. Ballard, chairman of the ASCE Committee on Employment Conditions, whose topic was "Employment Conditions and Salaries." Dean Grinter urged that engineering education be fashioned for a future in which atomic power will prevail.

Important Technical Program

Wide coverage was given technical problems and developments in the 22 sessions sponsored by the ASCE Technical Divisions. Many of the papers dealt with local projects, including Buford Dam, the Clark Hill Dam and Power House, the Savannah River Bridge, the Atlanta Expressway System, and the Alabama Livestock Coliseum. Several of the 80 papers constituting the program appear as articles in this issue.

Southern cities have an opportunity to avoid the serious mistakes of urban development made by most cities in more highly urbanized sections of the country, H. K. Menhinick, professor of city planning at Georgia Institute of Technology, pointed out in a paper given at a session of the City Planning Division. City planning instruction at the Institute has been influenced by the rapid industrialization and urbanization of the South, he noted. "A significant current development is a cooperative program of city planning instruction, research, and development in the South, jointly participated in by Georgia Tech, the University of North Carolina, the University of Oklahoma, and the Southern Regional Education Board," Professor Menhinick said.

Of wide general interest was a paper by Thorndike Saville, dean of engineering at New York University, on "National Water Policy Problems," which led off a Symposium on Water Resources sponsored by the Sanitary Engineering Division. Dean Saville took the stand that, "The federal government should build, finance, and operate water resources projects only to the extent that private capital and local government cannot do so." Congressional policy based on that premise is fundamental to formulation of a sound national water policy for conserving and developing the country's limited water resources, he declared. He opposed the solution proposed by the President's Water Policy Commission in 1950, which he said was "based on the welfare state directed by an all-wise federal bureaucracy."

Engineers Address Local Groups

As part of the Society's continuing program of attempting to increase public awareness of the contributions of the

Glimpsed at general session of Society's newly formed Committee on Conditions of Practice, which held its first meeting during Atlanta Convention, are Vice-President G. Brooks Earnest (left), chairman of committee and presiding officer, and James I. Ballard, chairman, ASCE Committee on Employment Conditions, and one of the panel of speakers.

The two-day Local Section Conference (right) was heavily attended, and discussion at its usual clarifying level. Attention was given to public relations possibilities and to the program of selecting the Seven Engineering Wonders as a means of increasing public knowledge of engineering.

More than 500 attended the Wednesday "Welcoming Luncheon" and heard Governor Talmadge extol the profession. Guests of honor, seated on the dais, included Society and Section officials.

Authors' Breakfasts served as briefing sessions for the many authors and speakers highlighting the Atlanta Convention program. Viewed at this breakfast, in usual order, are E. S. Harrison, member of Executive Committee of Power Division and presiding official at Power Division sessions; George P. Palo, engineer for the Tennessee Valley Authority; Howard K. Menhinick, professor of city planning at Georgia Tech; Section President C. E. Drummond; Harold T. Larsen, manager of Technical Publications; C. P. Lindner, chairman, Technical Program Committee, and presiding official; Don P. Reynolds, assistant to the Secretary of ASCE; Van Porter Enloe, superintendent of Atlanta Sewage Treatment Plant; Alfred Hedefine, Parsons, Brinckerhoff, Hall & Macdonald, New York; Richard J. Adams, Sherlock, Smith & Adams, Montgomery, Ala.; and Josef C. Patchen, Patchen & Zimmerman, Atlanta.

profession to its welfare, Society officers addressed local civic groups. In an address before the Engineering Society of Georgia, ASCE Vice-President Mason G. Lockwood warned of the danger of too little attention to the human factor. He urged his hearers to remember that "as a profession we do nothing except for man." To remedy the tendency to be too much preoccupied with technical matters, Mr. Lockwood suggested study of subjects to help engineers get along with all kinds of people.

Record Registration

The registration of almost 1,400 (a new Winter Convention high) included 267 students, for whom a two-day program of technical papers and inspection trips had been arranged. The farthest point represented in the attendance was Sydney, Australia.

Program Provides Many Innovations

The smooth operation of the Convention and the large and enthusiastic attendance attested to long months of preparation by the Convention committees headed by Moses E. Cox and by Director James A. Higgs. There was much emphasis on hospitality and on innovations aimed at breaking the ice and giving everyone a good time. The "Ice-Breaker" party, given by the Georgia Section for all hands on Wednesday evening, was attended by more than 900. The famous Georgia Tech Glee Club entertained with its repertoire of songs, including "The Rambling Wreck," which have made big hits on its tours. Instead of the traditional head table for the Thursday evening dinner dance, two Directors were seated at each of several tables, where first comers joined them.

Other Convention week events included a two-day Local Section Conference; the Convention Luncheon featuring a talk by President Terrell on Thursday; Sanitary Engineering and Hydraulic Division luncheons on Friday; and an inspection trip to Buford Dam. Georgia Section wives, under the capable direction of Mrs. C. E. Drummond and Mrs. R. E. Stiemke, entertained for the visiting ladies.

Atlanta Actions of ASCE Board of Direction Briefed

The ASCE Board of Direction met during the Atlanta Convention, February 15-19, with all members present. Principal actions taken by the Board during its Atlanta sessions are summarized here.

Balloting for Dues Increase Scheduled

Ballots to the membership on the proposed amendment to the constitution to increase Society dues (see page 74) will be mailed from headquarters on or about May 1, 1954, with provision for their return and count on or about June 1. Final canvass will be at the business meeting of the Society scheduled for mid-June at the Atlantic City Convention.

Changes in Board Organization Studied

The Committee on Board Reorganization, which includes all members of the present Committee on Districts and Zones, was requested to study and recommend to the Board of Direction such changes in the constitution as may be necessary to provide boundaries of Districts and Zones that will assure flexibility and reasonably proportional representation.

Cost of Separates Higher Than Anticipated

The Committee on Publications reported that slightly over 50 percent of the members of ASCE have enrolled in Technical Divisions and that the current method of distributing the greatly increased numbers of Proceedings Separates is proving much more costly than the Committee had originally anticipated.

1956 Winter Convention Scheduled for Dallas

The Board accepted an invitation from the Texas Section to hold the 1956 Winter Convention of the Society at Dallas, Tex. Future Convention commitments are: 1954—June, Atlantic City, N.J.; October, New York, N.Y. 1955—February, San Diego, Calif.; June, St. Louis, Mo.; October, New York N.Y. 1956—February, Dallas, Tex.; June, Knoxville, Tenn.; October, Pittsburgh, Pa.

Advertising by Engineers Studied

Board action resulting from the report of the Committee on Professional Conduct on competitive bidding for professional services is shown elsewhere in this issue. On the subject of advertising by engineers, the Board requested study by the Committee on Professional Practice, with a view to setting up standards which would enable the establishment of a clear differentiation between proper and improper advertising by engineers.

Manual on Cost Control and Accounting for Civil Engineers

The Manual on Cost Control and Accounting for Civil Engineers, which has been in the making for over two years by the Committee on Professional Practice, was released for early publication as a Manual of Engineering Practice.

Help on Unionization Problems Pledged

Continuation of active headquarters-staff attention to unionization problems of engineers and current abuses of the Taft-Hartley law in certain areas as it relates to engineer employees was requested by the Committee on Employment Conditions and was pledged by the Board of Direction. The recent staff memorandum on "Engineers, Unionization and the Tax Status of ASCE" was commended by the Committee, and request for more published material along similar lines was made.

Publication of Salary Report Authorized

Publication was authorized for a recently completed report on salaries of professional and subprofessional engineers in the lower classification brackets, as sponsored by the Society's Committee on Salaries.

ASCE Policy on Federal Engineering Work Restated

A restatement of general Society policy regarding federal engineers on community facility projects was authorized as follows:

"Federal engineering activities concerning community facilities such as the design and construction of streets, water supply and sewerage works should never be considered as mere adjuncts to housing activities. The planning and federal approval for public works of this nature should be placed in charge of federal agencies, professionally experienced and qualified in these special fields. Federal public works in these fields should not be placed in charge of agencies responsible for the public housing and slum clearance activities of the federal government.

"Public works activities such as those mentioned affect not only metropolitan development but also rural and state development. They have little relationship to and require an entirely different type of personnel from slum clearance activities."

Resolution of Appreciation to Carl E. Beam

A resolution of appreciation was presented to Carl E. Beam by President Terrell. Mr. Beam, at his own request, has been placed on retirement status from Society staff service, begun in 1921.

Secretary Carey Requests Retirement

Executive Secretary Carey, appointed to that office in 1945 requested retirement in January 1955. The Board concurred that he be placed on retirement status some time in 1955. The Board appointed a Special Zonal Committee, consisting of the four Vice-Presidents, Messrs. Friedman, Earnest, Needles and Lockwood, to study the problem and make appropriate recommendations to the Board of Direction.

Board Opposes Competitive Bidding

At the Atlanta meeting of the Board of Direction, February 15-16, the Committee on Professional Conduct submitted the following comment regarding current discussion of certain aspects of the ASCE Code of Professional Ethics. The Board formally approved the statement and requested that it be given appropriate publicity.

Current discussion of ethics in engineering seems to have ignored the point that the practice of a profession should be on a higher plane than what is generally thought of as business, however sound the basis on which the latter may be conducted.

It may be adequate for the businessman to provide a product that meets the request of his customer at minimum cost and at maximum profit to himself. The professional man must go beyond merely meeting his client's request. He must study the problem presented to be sure of the best long-range solution and may even find it necessary to advise that his client's approach be changed completely.

A professional engineer working for an inadequate fee can prepare plans and specifications in such a way as to save money for himself at the expense of the client, who as a result may pay greater costs for construction and for extras. While such a practice is not necessarily a part of competitive bidding, it is more likely to result where price competition forces a bidder to cut the quality and thoroughness of his work.

The professional engineer should act for his client in professional matters as a faithful agent, giving to each problem to the best of his ability the benefits of his training, experience, and judgment. For such services, the engineer should ask and receive adequate compensation. Such standards of service cannot be rendered if the engineer offers to do the work for less than an adequate fee or for less than cost.

Competitive bidding for engineering services is against the best interests of the client and the public as well as those of the engineer himself.

Unless the practice of professional engineering can be maintained on a high professional standard, the quality of the work done will be lowered. It is not a question of sound business principles alone but of ethical procedures or standards of professional practice.

If one is to accept the inference from recent writings that that which is unethical may nevertheless be sound business, there is all the more reason for the profession to resist pressure to lower its standards and to insist on even more rigid adherence to its code of ethics, primarily for the protection of the public.

Board Acts on Engineer Bidding in South Carolina

At its February 15, 1954, meeting in Atlanta, Ga., the Board of Direction instructed the Executive Secretary to prepare a factual statement relating to the case of engineer bidding in South Carolina and to publish the statement in "Civil Engineering." The statement follows.

The Code of Ethics of the American Society of Civil Engineers, to which each member subscribes as a condition of his membership in the Society, contains the following:

"It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers . . .

* * *

"To participate in competitive bidding on a price basis to secure a professional engagement."

Members of the Society convicted of violating its Code of Ethics are subject to expulsion from the Society or to such other disciplinary measures as the Society's Board of Direction may decide.

Under date of September 24, 1953, the South Carolina State Highway Department advertised for bids for the furnishing of professional services to the state in the notice quoted here:

"S. C. STATE HIGHWAY DEPARTMENT
COLUMBIA, S.C.

September 24, 1953

Notice to Bridge Engineers

"Notice is hereby given that sealed bids will be received on Tuesday, October 27, 1953, by the Department, at the address shown below, for engineering services in

connection with a proposed movable span in a bridge over Wappoo Cut (Intracoastal Waterway) on Route 700 near Charleston, S.C.:

> The engineering services desired are the preparation of detailed plans, specifications, and/or special provisions for a double-leaf bascule superstructure, machinery, and electrical equipment, and the two piers supporting such items. The roadway width is 50 ft between curbs and 2.5-ft sidewalks and the design capacity is H15-S12.
>
> "Bids must be submitted on official proposal forms, copies of which may be obtained at the address shown below. Bids must be based on a percentage of the contract costs of the portion of the bridge stated above. Lump Sum bids will not be accepted. The Department reserves the right to reject any or all bids, waive technicalities, and to make such award as it deems to be to its best interest.
>
> *Signed:* C. R. McMillan
> C. R. McMillan, *Chief Highway Commissioner S. C. State Highway Department*
> S. C. State Department Building
> Columbia, S. C."

Engineers interested were furnished by the South Carolina State Highway Department a "Proposal Form," which is quoted below.

"PROPOSAL FORM

BID FOR ENGINEERING SERVICES
FOR
PROPOSED BRIDGE OVER WAPPOO CUT (INTRACOASTAL WATERWAY) ON ROUTE 700 NEAR CHARLESTON, S. C.

S. C. STATE HIGHWAY DEPARTMENT
COLUMBIA, S. C.

Proposal Form

Proposal of _____
(Name)

_____
(Address)

"In accordance with the advertisement of the S. C. State Highway Department dated September 24, 1953, — propose to furnish the engineering services listed below in connection with the proposed bridge over Wappoo Cut (Intracoastal Waterway) on Route 700 near Charleston, S. C. for —% of the contract costs of the items involved. The services to be furnished are:

1. Detailed plans on tracings of a double-leaf bascule superstructure, machinery, and electrical equipment and also of the bascule piers with 50-ft roadway between curbs and 2.5-ft sidewalks, metal railing, metal floor and to a design capacity of H15-S12.

2. Complete supplemental specifications and/or special provisions other than the Department's "Standard Specifications for Highway Construction" dated March 15, 1939, that are necessary to describe the bids for and construction of the portion of the bridge stated above in Paragraph 1.

3. The check of the contractor's shop drawings for the bascule superstructure and also specifications of the various equipment items that are a part of the portion of the bridge stated above in Paragraph 1.

"It is understood that the preparation of plans and specifications for the remainder of the proposed bridge and the field engineering supervision of the entire bridge will be performed by the Department's regular forces. It is further understood that a schedule of partial payments satisfactory to both parties will be agreed upon before this proposal becomes binding. It is also understood that the S. C. State Highway Department has the right to reject any or all bids, to waive technicalities, and to make such award as it deems to be to its best interest.

_____
By: _____"

On October 27, 1953, the State Highway Department opened fifteen "sealed bids" from engineering firms offering to perform the services outlined in the proposal. Some members of the ASCE appear to have been involved in these bidding procedures. A list of bidders and amounts bid for furnishing the engineering services outlined in the Highway Department proposal form quoted above is a public record and was so circulated by the Department after the bids had been tabulated. Anyone interested probably can obtain a copy of the list by writing L. C. Moltz, Office Engineer, South Carolina Highway Department, State Highway Building, Columbia, S.C.

In accordance with the proposal quoted, bids were made as a percentage of the construction contract costs of the items involved. For the fifteen bids received, the percentages bid ranged from 2.80 percent for the low bid to 7.25 percent for the high bid. Nine of the bids ranged between the 2.80 percent low and 4.00 percent. The engineering contract was awarded to the low bidder.

The apparent violation of the Society's Code of Ethics in this case came to the attention of the Board of Direction and of the ASCE Committee on Professional Conduct. The Committee took immediate steps to determine the persons apparently involved, and reported them to the Board of Direction at its Atlanta Convention meeting on February 15. The Committee recommended, and the Board of Direction concurred, that preliminary action be taken in the case, as follows:

"As a matter of preliminary procedure, the Executive Secretary is authorized and directed to write a letter to each member of ASCE apparently involved in the South Carolina bidding, calling attention to the apparent violation of Item 4 of the Code of Ethics and asking each to write a letter explaining his actions or to appear in person before the Committee on Professional Conduct for the same purpose."

From the results of the preliminary investigation ordered, the Committee on Professional Conduct will determine if the facts warrant that charges of unprofessional conduct be made, and the Committee will report accordingly to the Board of Direction at its next meeting. If such charges are made, the Board will then institute formal procedures looking to appropriate disciplinary action against the alleged violators of the ASCE Code of Ethics, as prescribed in the Society's constitution and by-laws.

The Committee on Professional Conduct and the Board are well aware of the gravity of the situation described and of the importance of proceeding in the prescribed orderly manner to the end that the final decision reached will be well considered and just.

Cooperative Ceremony Honors New Engineering Licensees

Metropolitan area sections of the four Founder Societies, the American Institute of Chemical Engineers, and the New York State Society of Professional Engineers cooperated in honoring local engineers who have successfully passed their licensing examination by sponsoring a special presentation ceremony, which was held at the Statler Hotel in New York recently. The joint group was welcomed by P. C. Rutledge, vice-president of the Metropolitan Section of ASCE, and the principal speaker was William H. Larkin, of the State Board of Examiners of Professional Engineers and Land Surveyors. The presentation of licenses was made by Newell L. Freeman, secretary of the State Board.

Pipeline Conference to Be Part of Texas Meeting

The Construction Division and the Texas Section are cooperating in sponsoring the first Pipeline Conference, to be held in Midland, Tex., April 9 and 10, as an integral part of the Section's Spring Meeting (page 81 for details). This panel program, sponsored by the Pipeline Committee of the ASCE Construction Division, will include the formation of a Texas Pipeline Group; technical sessions with nationally known speakers; and conferences on pipeline problems.

Friday, April 9, 2:00 p.m. (C. M. Davis, Chairman, Committee on Pipelines, ASCE, presiding)

Organization of Pipeline Group, Texas Section

2:30 "Pipeline Location Surveys"
Earl K. Monteith, Chief Engineer, Studdert Engineers, Midland, Tex.

3:00 "The Use of Aerial Photogrammetry in Pipeline Construction"
Ford Bartlett, President, Lockwood, Kessler and Bartlett, New York, N. Y.

3:45 "The New Edition of Section 8 of the Code of Pressure Piping"
Walter H. Davidson, General Superintendent, Transcontinental Pipeline Corp., Houston, Tex.; Subgroup Chairman, Testing and Operating, ASCE

4:30 Open discussion

Saturday, April 10, 10:30 a.m. (Pipeline Panel, with C. M. Davis, presiding)

10:30 "The Operations of a Gravity Gathering System"
E. R. Osburn, Consulting Engineer, Boulder, Colo.

11:15 Discussion

The conference will be of special interest to engineers and contractors in the oil and gas industries. Pipeline contractors, operators, and engineers who are not members of ASCE are invited to attend.

North Central Student Conference Planned

A change in the dates of the North Central Conference of Student Chapters to eliminate Easter weekend conflicts is announced by the University of Cincinnati Student Chapter, which will be host for the occasion. The conference has been advanced a day, making the dates the 14, 15, and 16th of April.

Le Roy K. Sherman, ASCE Honorary Member, Is Dead

ASCE Honorary Member Le Roy K. Sherman, died suddenly at his home in San Diego, Calif., on January 4, at the age of 84. A former resident of Oak Park, Ill., Mr. Sherman was engaged in private practice in Chicago from 1934 until his retirement a few years ago, serving as consultant to numerous government agencies and other organizations. An expert in hydraulics, he was best known as originator of the unit hydrograph. Mr. Sherman graduated from Massachusetts Institute of Technology in 1892 and, after a brief period in railroad work, became assistant engineer on the construction of the Chicago Drainage Canal. From 1905 to 1912 he was resident engineer for the Sanitary District of Chicago, and from 1912 to 1917, president of the Chicago contracting firm, L. K. Sherman, Co., Inc. He was with the U. S. Housing Corp., in Washington, from 1918 to 1920, and president of the Randolph-Perkins Co. from 1921 to 1934.

A member of ASCE since 1910, Mr. Sherman was named Honorary Member in 1946. He was chairman of its Water Policy Committee from 1938 to 1940.

Le Roy K. Sherman

Papers for Fifth Congress On Large Dams Due Soon

Engineers wishing to submit papers for the Fifth Congress of the International Commission on Large Dams are reminded by C. P. Vetter, chairman of the United States Committee on Large Dams, that the deadlines for receipt of papers and communications by the Reviewing Committee are, respectively, April 30 and June 30, 1954. Papers and communications should be submitted (in triplicate, if possible) to Walter Dreyer, Chairman of the Reviewing Committee, USCOLD, % Pacific Gas & Electric Co., 245 Market Street, San Francisco 6, Calif. Inquiries regarding preparation of the papers should be submitted to C. P. Vetter, Chairman of the United States Committee, P.O. Box A-A, Boulder City, Nev.

The Reviewing Committee will recommend papers and communications which will be submitted officially by the U.S. Committee on Large Dams and printed in the Transactions of the Congress without cost to the authors. It may also recommend that certain papers and communications be submitted unofficially and printed at the authors' expense. All members of the U.S. Committee are urged to submit papers. Papers from nonmembers may be recommended for publication at the discretion of the Reviewing Committee. The Fifth Congress on Large Dams will be held in Paris in 1955.

Index to Society Regulations

A combined index to the Society's Constitution, By-laws, and Rules of Policy and Procedure is now available, without charge, upon request to the Executive Secretary, ASCE, 33 West 39th Street, New York 18, N.Y. The index is reproduced by the multilith process, 11 pages, $8^1/_2 \times 11$, and refers to the official documents as they appear in the Official Register, January 1, 1954.

District 14 Council Meets in St. Louis

Problems of mutual Society and Section interest up for discussion at the annual meeting of the District 14 Council, which was held in St. Louis on February 6, included the proposed amendments to Society by-laws; the proposed dues increase; redistricting; ways and means of holding Junior Members; a possible new headquarters building for the Engineering Societies; and special problems confronting District 14.

New officers, elected during the meeting, are John I. Parcel, of the St. Louis Section, president; S. W. Chandler, of the Mid-South Section, vice-president; and J. Kent Roberts, Jr., of the Mid-Missouri Section, secretary-treasurer.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE — Field Representative ASCE

Legislation

With the approval of S. 2150 by the House Public Works Committee following its passage by the Senate, the St. Lawrence Seaway is closer to becoming a reality than it has ever been before. Every president since Theodore Roosevelt has taken a hand in promoting the idea, and it was with some surprise that the present administration succeeded in getting the proposal off dead center. Of course the fact that Canada is ready to proceed with a seaway of its own had an important influence. Further hurdles will be placed in the path of St. Lawrence Seaway legislation in the Rules Committee and on the floor of the House.

The bill would establish a government corporation to borrow $105,000,000 from the Treasury to finance the U. S. part of the construction cost of the seaway. Before approving the bill, the Public Works Committee amended the measure to require that all revenue from the seaway be earmarked for payment of the bonds.

In connection with this matter, the engineering profession was disappointed to learn that appointments to a "Board of Engineers" had been made without asking the advice of the profession and that the appointees were in fact not engineers but highly placed administrative officials. The engineering profession has no objection to the consideration of some aspects of this proposed development by officials who are not engineers. But it does feel that if the public is to be convinced the development is sound on the basis of the recommendations of a "Board of Engineers," then the members of the Board whose signatures are carried on the report should in fact be engineers who are staking their reputations on its engineering soundness. Engineers Joint Council has been in communication with the White House in an effort to adjust the matter.

The U. S. Court of Appeals upheld the Federal Power Commission in granting a license to the Power Authority of New York to build and operate hydroelectric facilities on the St. Lawrence.

The perennial Passamaquoddy tidal power proposal came to life again with the passage by the Senate of S.J. 12, providing funds for a survey of the economic feasibility of the project. Work on the project originally started in 1935 and was suspended in 1936. The survey would take two years to complete. The measure has been sent to the House.

An interesting bill, S. 2913, the Public Facilities Act of 1954, has been introduced by Senator Douglas of Illinois. This bill provides for formulation of public works programs to aid in the construction of public facilities needed by the federal government, state and local governments and other public bodies. It would involve financial assistance, either direct or through guarantees or by providing a secondary market for securities. Advance planning activities for such works would also be included. The bill contains ideas, both good and otherwise, based on the operations of former government agencies which are now defunct, designed to promote economic stability through the use of public works. This must be viewed as a precautionary proposal, for most indications point to a large construction volume in 1954.

S. 2758 and H.R. 7341, administration-sponsored bills, would increase government funds available for hospital construction. They would authorize federal assistance for the construction of non-profit hospitals for the chronically ill, convalescent centers and diagnostic centers.

Housing legislation will probably provide for attaching some public works activities to the slum clearance work of the Housing and Home Finance Agency. Slum clearance activities have usually been found to require very large subsidies.

An administration bill, H. R. 7818, to increase federal aid highway fund allocations by 50 percent and reduce federal control over state spending of such allocations is under consideration. The bill is predicated on extension of the federal gasoline tax at 2 cents a gallon. The tax is scheduled to drop to 1½ cents on March 31, but the President has recommended extension of the 2-cent rate.

H.R. 7818 would boost annual allocations from gasoline tax revenues to $864,500,000 for fiscal 1956 and 1957, compared to $575,000,000 under existing law. The tax brings in about $910,000,000 a year. The President favors putting it back into highways. Largest increase under H.R. 7818 would be from the present $25,000,000 to $200,000,000 for interstate defense highways.

The House Ways and Means Committee will soon consider in executive session whether or not to incorporate the provisions of the Reed-Keogh bill in the general tax revision legislation. This measure, in support of which Engineers Joint Council and other professional groups made strong presentations last year, would provide personal income-tax exemptions for annual sums laid aside to build up retirement funds by professional workers, including engineers. Meanwhile legislation has been introduced to bring self-employed professional workers into the Social Security system. Sentiment among engineers is said to be divided on the merits of inclusion in Social Security. The American Bar Association and the American Medical Association will probably strongly oppose such inclusion.

ASCE MEMBERSHIP AS OF FEBRUARY 9, 1954

Members	8,531
Associate Members	10,913
Junior Members	17,569
Affiliates	69
Honorary Members	42
Total	37,124
(December 9, 1953	35,859)

Competitive Price Bidding for Professional Services

As has been mentioned in this column during the past several months, the matter of competitive bidding for engineering services has required some attention. Of three such situations that have received much publicity, one was wholly corrected, another corrected in considerable part, and the third is still pending. Bidding for engineering services is at best a questionable practice. Of course there are variations of price cutting detrimental to the profession, but the situation currently discussed in recent editorials appears to include both public advertising for design bids and a public bid opening. The subject has been given such attention in several leading technical magazines as to give the impression that the profession is struggling to keep the practice from overwhelming it and relegating into the background the practice of negotiating in accordance with our professional standards, particularly where government bodies are concerned. That is a grossly exaggerated view.

The Defense Department, the Atomic Energy Commission, and other leading agencies have definite rules providing for negotiation without competitive price bidding. In any event, it is a rare practice, a discredited practice, and a demonstrably uneconomic practice.

The one-hundredth of one percent of work on which bids are invited is an irritating situation but gives no grounds for concluding that such bidding is a prevailing practice or one tending to stifle the ethical procedures that are accepted as a matter of course by nearly all government construction agencies. It is essential to keep this matter in proper perspective in reading extensive discussions pro and con. Engineers who refuse to submit bids in response to published advertisements may rest assured that their stand is sound and will continue so.

Washington, D.C.
February 15, 1954

Committee Heads Plan Pacific Southwest Conference

In charge of the multitudinous details involved in carrying out a smooth-running convention program are these committee chairmen for the Pacific Southwest Conference, to be held in Sacramento, Calif., April 28–May 1. Seated, left to right, are L. K. Jordan; C. A. Ecklund, president of the Sacramento Section; W. G. Schulz, chairman, Conference Interim Committee; R. Robinson Rowe, general conference chairman; J. L. Beaton; M. A. Ewing; and Stewart Mitchell. Standing, in the same order, are W. L. Horn, F. W. Panhorst, J. C. Jennings, D. H. Rutledge, R. M. Gillis, H. O. Banks, R. W. Hutchinson, W. L. Berry, R. M. Carmany, M. H. Blote, and J. G. Meyer. Details about the program, which will include two days of technical sessions and trips to Folsom and Nimbus dams and Sacramento's new sewage treatment plant, will be given in the April issue. The Hotel Senator will be the headquarters hotel. Early requests for hotel reservations, accompanied by a $5 deposit, should be sent to D. H. Rutledge, Box 197, Town and Country, Sacramento 21, Calif.

Junior Members of Virginia Study Opportunities for Improved Status

Improvement of professional status through the use of available opportunities was the theme of a recent full-day Conference of Junior Members sponsored by the Virginia Section. The conference, the first of its kind, demonstrated the enthusiasm younger members have for activities concerned with professional advancement. Held in Richmond on February 6, a Saturday, the conference was attended by 85 Junior Members from all over the state. Two similar sessions, which will reach all sizable groups of younger members in the state, are planned.

The program, arranged by Col. R. A. Marr, Jr., a member of the ASCE Committee on Junior Members, featured three panel discussions. The first, entitled "You and Your Job Prospects," consisted of factual presentations by Gen. James A. Anderson, Virginia State Highway Commissioner; Col. Burt L. Knowles, field engineer for the Associated General Contractors of America; and Calvert G. De Coligny, of the Virginia Manufacturers Association. The conclusions of this panel were optimistic especially in view of the growing ratio of engineers to all other employment classifications in industry.

A second panel, entitled "Improving Your Professional Status," featured discussions by Turner N. Burton, of the Virginia Department of Professional and Occupational Registration, and Don P. Reynolds, Assistant to the Secretary of ASCE. Organization opportunities and the legal status of engineers were described, with emphasis on the need for individuals to take advantage of such channels for recognition and advancement.

"Self-Improvment for Advancement" was the general subject of the third panel. William R. Glidden, assistant chief engineer of the Virginia Department of Highways and a former Vice-President of the Society, cited the continuous growth demanded of engineers, both professionally and as individuals. Educational opportunities for Junior Members of the Virginia Section were described by Professors W. T. Sinclair and Charles N. Gaylord, of the University of Virginia.

In attendance, to relate the interests and needs of Junior Members in Virginia to those elsewhere, was Prof. J. M. Garrelts, chairman of the ASCE Committee on Junior Members. Professor Garrelts appealed for informed participation of individuals in Society activities, citing many areas in the conditions of engineering practice and employment where such participation has been notably successful. Presiding for the Virginia Section was T. E. Shelburne, president, and E. S. Mullen, senior vice-president.

Coming Events

Buffalo—Dinner meeting with ASCE President Daniel V. Terrell as guest of honor, March 16.

Cincinnati—First Sanitary Engineering Workshop sponsored by the Section will meet in the Rockwood Room, Hotel Sinton, Cincinnati, Ohio, April 3.

Delaware—Meeting at the University of Delaware, March 16.

Kansas—Dinner meeting at the Elks Club in Topeka, March 19, at 6:30 p.m.

Maryland—Dinner meeting at the Engineers Club of Baltimore, March 10, 7 p.m. Cocktails at 6.

Metropolitan—Dinner meeting in the Georgian Room of the Hotel Statler, New York, N.Y., March 17, at 6:30 p.m. to be addressed by Dr. Lillian Gilbreth.

Mohawk-Hudson—Dinner meeting in the Albany area on March 19 to meet President D. V. Terrell. Further information available from the Secretary of the Section, Herbert J. Johnson, c/o Grade Crossing Bureau, N.S.D.P.W., State Office Building, Albany, N.Y.

Mid-South—Meeting of the Little Rock Branch at Granoff's Restaurant, Little Rock, Ark., March 17, at 7 p.m.

New England Council—All-day regional conference of New England Sections (Connecticut, Maine, Northeastern and Providence) at Massachusetts Institute of Technology, Cambridge, Mass., March 20. New England members may make reservations through the Local Section secretaries.

Pacific Southwest Conference—Seventh Annual Pacific Southwest Conference at the Senator Hotel, Sacramento, Calif., April 29–May 1. Official participants will be the Arizona, Hawaii, Intermountain, Los Angeles, Oregon, Sacramento, San Diego and San Francisco Sections, as well as all Subsections and Student Chapters for these areas.

Syracuse—Dinner meeting, with President Terrell as guest of honor, at the Hotel Syracuse, March 17.

Texas—Spring meeting to be held at the Hotel Scharbauer, Midland, Tex., April 9 and 10. Soil mechanics, water resources, and sanitary engineering sessions, beginning Friday morning, April 9, in addition to the Construction Division's First Pipeline Conference (page 79). Dinner-dance Friday evening, and field trips Saturday afternoon. Requests for reservations should be made to V. E. Young, P.O. Box 1000, Midland, Tex.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

The **Arizona Section** was active in a statewide program prepared by a joint engineering group to celebrate National Engineers' Week, proclaimed by President Eisenhower for late in February.

James B. Eads—the history of his salvage work on the Mississippi, his work with gun boats during the Civil War, and his famous bridge across the Mississippi at St. Louis—was the subject matter of an interesting talk heard by members of the **Central Illinois Section** at the annual Ladies Night meeting in Urbana on January 19. The speaker was Prof. Cyrus E. Palmer, associate dean of the College of Fine and Applied Arts at the University of Illinois and an author of note.

Top engineering achievement in the **Central Ohio Section** area, as the Section sees it, is the Columbus Civic Center. The other six named, in the order of selection, are (2) the Muskingum River Flood Control Project; (3) the Columbus Airport; (4) the Ohio State University Stadium and Medical Center; (5) the Columbus Water Supply Reservoirs and Softening Plant; (6) National Highway, U. S. Route 40; and (7) the Poston Power Plant.

The spotlight was on students at the **Cincinnati Section's** annual joint dinner meeting with the University of Cincinnati Student Chapter held on the college campus on January 20, with Emerick Gross, Chapter president, in the chair. Tributes were paid the Chapter by Prof. Cornelius Wandmacher, by Section President Sven Sjodahl, by ASCE Director Warren W. Parks, and by Edward C. Harding, who was himself honored with a certificate of life membership. There were two student speakers—Gordon W. Foster and Howard C. Pettibone.

Fundamentals of good welding practice were outlined by Fred L. Plummer, director of engineering for the Hammond Iron Works and president of the American Welding Society, in the featured talk at the **Cleveland Section's** January meeting. Mr. Plummer's colored slides of welded projects included the Mexico City Municipal Auditorium which, he said permitted a 50 percent saving in structural steel. Welded box trusses from 295 to 320 ft in length were used in the structure. Installation of 1954 officers was another feature. They are Mauno Backlond, president; W. B. Auping, vice-president; and Michael J. Phillips, secretary-treasurer. Life memberships in the Society were announced for Nathaniel Finestone, Frank L. Gorman, John M. Heffelfinger, Jr., and Lorin S. MacDowell.

New **Connecticut Section** officers are John F. Willis, president; Robert P. Vreeland, vice-president; and Earl R. Howard, secretary-treasurer. The slate was unanimously elected at the Section's annual meeting in New Haven, on January 20, which also featured presentation of certificates of life membership to Harold L. Blakeslee and Adolf Hinrichs. Recipients unable to attend are Herbert C. Elton and Frank A. Holby. T. G. Looney, assistant professor of civil engineering, was guest speaker, with a talk on member participation in the Technical Divisions.

At its annual meeting, on January 18, the **Duluth Section** unanimously elected new officers—John Fredin, president; John Bovee and Arthur Tews, first and second vice-presidents; Myron Thompson, secretary; and Donald Anderson, treasurer.

Executive Secretary William N. Carey was featured speaker at a meeting of the **Florida Section's West Coast Subsection** in Tampa on January 25. He stressed the necessity for unity of the present engineering societies, referring to the success of such unified groups as EJC in securing provisions beneficial to the profession in the Taft-Hartley Law.

The Intermountain Section is urging immediate authorization and construction of

New officers of the Vicksburg Branch of the Mid-South Section, elected at a recent meeting at the Waterways Experiment Station, are shown in this view. In usual order they are John H. Bigham, secretary-treasurer; Joseph B. Tiffany, Jr., president; and Walter E. Best, vice-president. Willard J. Turnbull, chief of the Soils Division at the Station, discussed the registration of engineers from the standpoint of public welfare.

Karl A. Sinclair (third from right), former city engineer of Honolulu and now on special contract assignment with the city, receives his certificate of life membership in the Society at a meeting of the Hawaii Section. Reading left to right, are Francis Wai, treasurer of Section; G. C. Wallace, Section president; Ellwood C. Wilder, life member; William Wachter, secretary; Mr. Sinclair; Arthur Akinaka, vice-president; and ASCE Honorary Member Frederick Ohrt.

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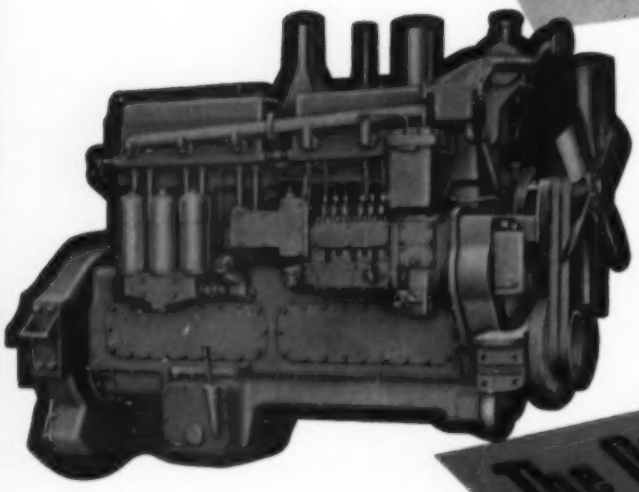

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J. R. Stitt (second from left), research and welding engineer for R. C. Mahon Co., of Detroit, gave a lecture on welding at the Nebraska Section's January meeting in Omaha. More than 100 members and guests turned out to hear Mr. Stitt and to see his actual demonstration of flame-straightening by use of oxyacetylene equipment. Pictured, in usual order, are John D. Griffiths, Mr. Stitt, Section President Douglas D. Lewis, and F. R. Smith

Guest of honor and featured speaker at the Kansas City Section's January meeting was ASCE President Daniel V. Terrell (left). There were more than 160 present to hear Dean Terrell, who is shown with Richard R. Tipton (center), newly installed as Section president, and T. J. Cambern, installed as secretary-treasurer. Also taking office during the meeting were Glenn E. Hands and Waldo R. Kell, first and second vice-presidents.

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the Echo Park and Glen Canyon units of the Colorado River Storage Project in a resolution prepared at its January meeting for transmittal to members of the Senate and House of Representatives from Utah and to the chairmen of the appropriate committees. A talk on "Geological Formations in the Vicinity of Salt Lake City and Their Influence on Engineering Structures," given by Prof. Ray E. Marsell, constituted the technical program.

To keep itself informed of legislation of interest to engineers and the Society, the **Ithaca Section** has appointed a Legislative Committee. Featured speaker at the January dinner meeting, held on the Cornell Campus, was John Burton, Chairman of the New York State Power Authority, whose subject was "The Law and Economics of New York State's Plan for the Niagara and St. Lawrence."

The Seven Engineering Wonders of the Chicago metropolitan area, as seen by the **Illinois Section,** are (1) the Lake Shore Drive and Park Development; (2) South Chicago and the Gary Steel Mills; (3) the Sanitary and Ship Canal, which makes it possible to reverse the flow of the Chicago River; (4) the Bascule Bridges over the Chicago River; (5) the Merchandise Mart; (6) the Sewage Disposal System; and (7) the Home Insurance Building (erected in 1885 and chosen because it was the first skyscraper).

Five new life members in the **Kansas Section** were honored at the Section's annual meeting in Topeka on January 15. They are Leroy Arnold, Calvin M. Cooper, Frank Helm, Monroe A. Stainer, and Martin W. Watson. New officers, elected at the same meeting, are Emory Bond, president; W. E. Gibson, vice-president; and Howard Hobrock, secretary-treasurer.

Members of the **Kentucky Section** have selected the following Engineering Wonders in their area: (1) the Louisville Flood Protection Project; (2) the Jefferson Davis Monument (the highest reinforced concrete monument in the world); (3) Wolf Creek Dam; (4) Egner's Ferry Bridge over Kentucky Lake; (5) Kentucky Dam and Lake, (largest dam in the TVA system); (6) the Illinois Central Railroad Bridge over the Ohio River at Paducah; and (7) the new State Office Building at Frankfort, a twelve-story welded steel frame on a friction-type pile foundation. New Section officers, elected at the annual meeting on December 8, are John H. Clark, III, president; G. R. Watkins, vice-president; M. I. Rorabaugh, secretary-treasurer; and John Heer, corresponding secretary.

Members of the **Los Angeles Section** have been serving on the Major Disaster Committee of the Los Angeles Council of Founder Societies, which is seeking a workable plan for using the 7,000 professional engineers in the area to best advantage in solving the engineering problems connected with civil defense.

At its annual meeting, in Pittsfield on January 23, the **Maine Section** elected Hamilton Gray, of Bangor, president; John O. Morton, of Concord, N. H., vice-president; Robert C. Haraden, of Manchester, Me., secretary; and Ralph Barnett, of Augusta, treasurer. Dr. Gray played a leading part in forming the Maine Section.

A double-header program on "Photogrammetry and Its Applications"—with Ford Bartlett and Lewis A. Dickerson, members of the firm of Lockwood, Kessler, and Bartlett, Inc., of Great Neck, N.Y., the speakers—featured the **Metropolitan Section's** January meeting. The talks and discussion brought out varied information: Ground control can be picked out even on air photos of deserts. Forested areas can be photographed better in winter when there is no foliage. The cost of 1:250,000 scale mapping of 100,000 sq miles can run from $3 to $8 per sq mile, depending on the cost of ground control. Color photos are still largely experimental in photogrammetry.

Oceanography as it touches upon engineering was the subject of a talk by G. F. Walton Smith, head of the University of Miami Marine Laboratory, given at the **Miami Section's** January meeting. Applications discussed by Dr. Smith ranged from the measurement of ocean currents by engineering devices to the development of paints for the protection of engineering structures from corrosion in seawater. Certificates of life membership were presented to three members of the **Palm Beach Subsection**—Ray W. Berdeau, Rudolf W. Beuttenmuller, and Willis G. Waldo.

Recommendations of the National Civil Defense Administration for designing to resist atomic attack were discussed at the **Northwestern Section's** January meeting by Prof. Joseph Wise, of the civil engineering department at the University of Minnesota. Professor Wise compared the relative costs of structures using the recommended design with those for usual design loads. A motion to invite the members of the Governor's Interim Committee on Water Works to attend the Section's next meeting

Scheduled ASCE Conventions

ATLANTIC CITY CONVENTION
Atlantic City, N.J.
Chalfonte-Haddon Hall
June 14–19, 1954

NEW YORK CONVENTION
Hotel Statler
October 18–22
1954

SAN DIEGO CONVENTION
Hotel U. S. Grant
February 6–11, 1955

was made and carried. New Section officers—elected on December 7—are T. R. Klingel, president; W. F. Arksey and T. W. Thomas, first and second vice-presidents; and J. E. Fant, secretary-treasurer.

A panel of engineers closely connected with the design of the Schuylkill Expressway presented a symposium on the project at the **Philadelphia Section's** January meeting. Taking part were John C. Floyd, project engineer for Michael Baker, Jr., Inc.; John D. Fuller, project engineer for Modjeski & Masters; Maurice E. Bender, assistant bridge engineer for Gannett, Fleming, Corddry & Carpenter, Inc.; and Bennett T. Gordon, partner in Richardson & Gordon. C. H. Buckius, chief engineer of the Pennsylvania Department of Highways, was chairman. Topic of discussion at the January meeting of the **Central Pennsylvania Subsection** was the Delaware River Suspension Bridge, under construction between Philadelphia and Camden and scheduled for completion in 1957 at an estimated cost of $80,000,000. The speakers were William F. Farnham, Harry J. Engel, and Homer R. Seely, project engineers for Modjeski & Masters–Ammann & Whitney.

ASCE Honorary Member Karl Terzaghi (left) of the Harvard University civil engineering staff and internationally known authority on soil mechanics, receives his certificate of life membership from Howard M. Turner retiring president of the Northeastern Section, at the Section's annual meeting on January 26. At the close of the meeting John B. Wilbur was inducted into office as Section president for 1954. E. L. Chandler, Assistant Secretary of ASCE, was featured speaker.

With the comment that it is no small task to select "Seven" from among the wonders wrought by engineers in the Pittsburgh area, the **Pittsburgh Section** has submitted its list of Engineering Wonders. For first choice, it lists "Structures that were pioneered in Pittsburgh," with special reference to Roebling's first suspension bridge, which carried the Pennsylvania Canal over the Allegheny River, and for second choice it names the hundreds of fixed bridges in Allegheny County. The other selections in the order named are (3) the Monongahela River at Pittsburgh, "the world's busiest inland waterway"; (4) "land transportation revolutionized by Westinghouse's invention of the air brake"; (5) Pittsburgh as a center of heavy industry; (6) smoke control as a cooperative project of the city's heavy industry; and (7) the Pittsburgh Redevelopment Program.

New **Puerto Rico Section** officers, elected at the Section's annual dinner meeting and dance in San Juan in December, are Franklin O. Rose, president; Don U. Deere, vice-president; and Stanley G. Kadala, Jr., secretary-treasurer. The featured speaker was Capt. N. J. Drustrup, public works officer for the Tenth Naval District, who reviewed construction activities in the District. In a talk on "Appraisals in Connection with Property Valuation for Insurance, Taxation, and Condemnation Purposes," given at the January meeting at the University of Puerto Rico, Jose M. Canals brought out the different methods of valuation used in Puerto Rico and described the part played by engineers in making appraisals.

Recent advances in the profession were stressed by the **Sacramento Section's** retiring president, Walter Schulz, in the president's annual report on "Progress in Engineering," given at the Section's January 5 meeting. Commenting on a new and intensified "professional awareness," he discussed as significant developments in engineering education and in-service training courses. New Section officers, elected at the annual meeting on January 12, are C. A. Ecklund, president; Loring K. Jordan and R. W. Hutchinson, first and second vice-presidents; and Joseph I. Burns, secretary-treasurer. The annual meeting was in two parts—the customary noon luncheon at the Elks Club for election of officers, and a dinner-dance preceded by induction of the new officers, at the Hotel Senator.

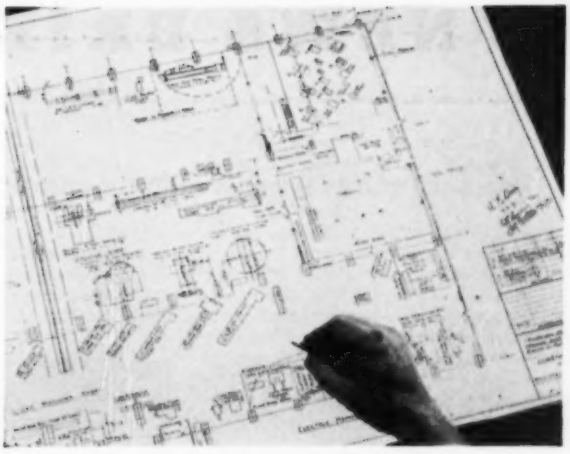
Legislation affecting the civil engineer was reviewed for the benefit of **San Diego Section** members at the January 26 meeting. The speakers were William White, executive secretary of registration for the state; Jack Long, president of the 1953 Legislative Council; and Phil Helsley, Legislative Committee chairman for the San Diego Section. Certificates of life membership were presented in absentia to P. E. Connors, John L. Steward, and Lawrence W. Klauber.

The micro-wave relay system of communication now being used to bring television programs and long-distance telephone calls into San Antonio from the North was described at a recent meeting of the **San Antonio Branch** of the **Texas Section** by Roland Landers, of the Southwestern Bell Telephone Co.

Members of the **West Virginia Section** have selected for the Seven Engineering Wonders in their area: The West Virginia Turnpike; the Kanawha County Airport; Bluestone Dam; Tygart Valley Dam; the Carbide & Carbon Chemicals Co. plant at South Charleston, W. Va.; the Appalachian Power Plant at Glasgow, W. Va.; and the Roller Gates in the Gallipolis Dam on the Ohio River.

A "Contractors' Meeting," sponsored by the Junior Activities Committee of the **Wisconsin Section** on February 3, featured an excellent open forum on "Building Construction from the Contractor's Point of View." The speakers were J. P. Gebhard, president of Gebhard-Berghammer, Inc.; Robert C. Johnson, president of the Siesel Construction Co.; and Fred Schelong, general superintendent for the Klug & Smith Co. At the close of the technical program the Blatz Brewing Co. entertained the 250 engineers in attendance with a buffet luncheon.

New life members in the Seattle Section area were honored by the Section at its January meeting. Reading from left to right, the veteran members are Herman C. Witte, M. O Sylliaasen, Roy E. Smith, Joshua H. Vogel, and Roland H. (Bill) Wilcomb. The sixth recipient, Thomas D. MacNeil, was not available for a photo. In the featured talk, Prof. J. Kenneth Pearce interestingly described his duties as foreign consultant in Surinam (formerly Dutch Guiana) for the International Bank for Reconstruction and Development.



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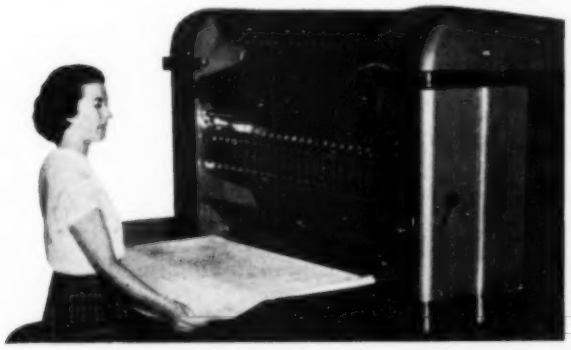

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NEWS BRIEFS . . .

Two Contractors Receive Moles' Construction Awards

The highest honor attainable in the heavy construction field was accorded two contractors—J. Rich Steers, of New York, and Glenway W. Maxon, of Dayton, Ohio—at the Moles' annual banquet, held at the Waldorf-Astoria in New York on February 3. Messrs. Steers and Maxon became the 14th pair of winners of Moles' awards, given annually to one member and one nonmember for outstanding achievement and contributions to the art of heavy construction. Previous winners include former President Herbert Hoover, Admiral Ben Moreell, and Gen. Brehon B. Somervell, Honorary Members of ASCE, and Robert Moses.

ASCE Past-President Carlton S. Proctor, a past-president of the Moles, made the member award to Mr. Steers, himself a past-president, in recognition of "his enterprise and engineering skill at home and abroad, notably in the fields of harbor, airfield, and railroad construction." Lester C. Rogers, M. ASCE, presented Mr. Maxon's award, which paid tribute to "his ability, leadership, and accomplishments, notably in the fields of public service, atomic energy, and lock and dam construction."

Rear-Admiral John R. Perry, chief of the Navy's Bureau of Yards and Docks, was the principal speaker. He paid tribute to the many contributions made by the Moles to the construction tasks of the war, and of the post-war period. Moles' president Richard E. Dougherty, Past-President of ASCE, presided at the banquet.

This year's recipients of Moles' awards—J. Rich Steers (left), of New York, and Glenway Maxon (center), of Dayton, Ohio—receive their plaques at the Moles' annual banquet at the Waldorf-Astoria in New York on February 3. At right is Lester Rogers, M. ASCE, of Chicago, who presented Mr. Maxon's award. United Press Photo.

Work Progresses on Harlem River Twin-Lift Bridge

This $18,000,000 twin-lift bridge, being built by the New York Central over the Harlem River at 132nd Street, New York, is about half finished. Replacing a 56-year-old swing bridge, the new structure will consist of two practically identical spans—each 340 ft long, weighing 1,400 tons, and carrying two tracks. It will lift 135 ft in 90 sec—twice the opening and closing speed of the swing span. By late summer, southbound trains will be switched off the old bridge to the west half of the new one. Northbound trains will run on the east span by the spring of 1956. The bridge was designed by New York Central engineers, and the towers and lift machinery by Hardesty & Hanover. Joint venturers on the substructure were the Walsh Construction Co., Peter F. Connally, and Senior & Palmer. The steelwork, which is starting now, will be handled by the American Bridge Division of U. S. Steel.

Ecuador Gets International Bank Funds for Road Program

With a loan of $8,500,000 from the International Bank for Reconstruction and Development, Ecuador will launch a highway construction program primarily designed to stimulate the agricultural development of the Province of Guayas and neighboring parts of the coastal region. Though the coastal region is extremely fertile, only about 1,250,000 acres of land are under cultivation because of the difficulty of transportation in the area. Existing roads are for the most part unpaved and become impassable in the five-month wet season, with the result that perishable produce is wasted.

Under the highway construction program, eight of the existing roads radiating from Guayaquil, Ecuador's largest city and most important port, will be converted to all-weather highways. The individual roads, which will have a total length of about 365 miles, will be integrated with a national highway network being planned by the government and will contribute toward making year-round transportation possible between Guayaquil and Quito, Ecuador's two principal cities.

The program will require about four years to complete, and will cost almost $12,000,000. The loan was made to the Comite Ejecutivo de Vialidad de la Provincia del Guayas, an autonomous local authority charged with responsibility for developing a road system in the province and for improving port facilities.

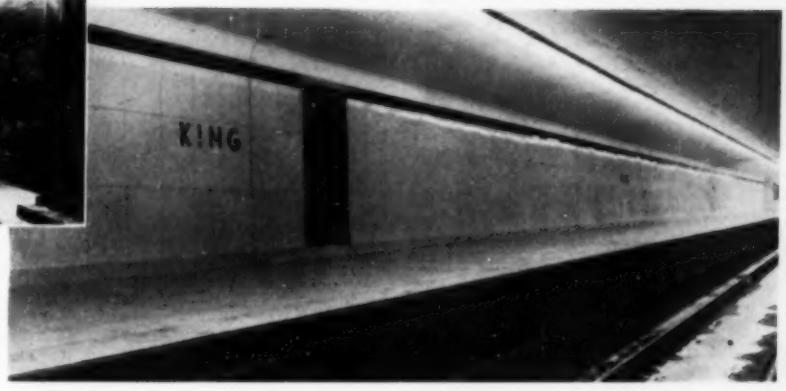
Construction Equipment Industry Meets in N.Y.

Some 2,300 manufacturers and distributors of construction equipment from all over the United States attended the 35th annual convention of Associated Equipment Distributors, held in New York, February 1–4. A series of sessions devoted to distributor management and sales problems shared the spotlight with distributor-manufacturer conferences, a series of talks on cost reduction, and a business meeting.

George W. Gagel, of Kansas City, Mo., was elected president to succeed S. John Oechsle, of Philadelphia. The other new officers are R. J. Finn, executive vice-president; S. F. Laskey, L. M. Doolen, and R. S. Hamilton, vice-presidents; and F. H. Fitzpatrick, treasurer.

The meeting marks the first time in more than a decade that the A.E.D. has held its convention in any city other than Chicago, where its national headquarters are located.

Toronto Subway Is Ready for Passengers



Toronto's new subway along Yonge St., under construction since 1949, is the first in Canada. In these views King Station is shown during construction (small photo) and upon completion. South of the station the subway passes under the Bank of Montreal. Photos by Canada Pictures Ltd.

Canada's first subway, a 4½-mile facility along Yonge St., Toronto, has been completed by the Toronto Transportation Commission at a cost of $58,500,000 and is ready to go into service. Actually March 30 has been set for the opening. The project goes back to 1946 when the city, which has a population of 1,250,000, approved a rapid transit plan by a nine-to-one vote in an initial effort to solve its growing traffic congestion and commuter problem. Construction began in 1949.

The new subway is modern in every respect. Its 104 English-built cars are capable of carrying 40,000 passengers per hour in each direction. Its stations are neon-lighted, walled with colored glass, and floored with terrazzo. The noise level is held down by several measures: by rubber pads mounted between the rails and concrete ties; by welding the rail joints; and by attaching acoustical material on tunnel and station surfaces below car-floor level.

The southern terminus of the subway is at the Union Station facing Lake Ontario on Front St., its northern terminus at Eglinton St., a free-transfer point to bus lines radiating to residential areas north, east, and west. The route lies under Yonge St., for the first two miles, and in open-cut right of way parallel to Yonge St. for most of the remaining distance to Eglinton Station. After April 1 the surface car line on Yonge St., will be discontinued, thereby speeding up auto traffic. Other extensions to the subway system are contemplated.

W. H. Paterson, M. ASCE, is chief engineer for the Toronto Transportation Commission; F. F. Boyce, M. ASCE, is staff engineer for De Leuw, Cather & Co., consulting engineers to the Commission; and ASCE Director Charles B. Molineaux is in charge of construction for one of the contractors—Pitts, Johnson, Drake and Perini. Articles by Mr. Paterson and Mr. Molineaux describing early stages of planning and construction were published in the March 1950 issue.

First Atomic-Powered Submarine Is Launched

The U.S.S. Nautilus, launched at Groton, Conn., on January 21, will be powered by the first atomic engine ever to propel a ship. Built by the Westinghouse Electric Corp., under contract with the Atomic Energy Commission, the power plant in the Nautilus is actually the second full-size power-producing atomic engine in history. The first atomic engine (Mark I), which was also built by Westinghouse, was a land-based prototype that began production of substantial quantities of power at its desert site in Idaho in May 1953. However, the Nautilus engine will be the first to provide the motive power for any vehicle or vessel by controlled nuclear fission. When completed, it will be the most powerful engine ever built. Fleet-type submarines in World War II had 6,000-hp engines.

In sharp contrast to the ordinary submarine, which must depend upon batteries when completely submerged and can consequently travel at slow speeds and for short distances only, the Nautilus will be capable of crossing the Atlantic submerged and at full speed. Because of the tremendous potential energy in a lump of uranium the size of a golf ball and weighing 2 lb—it is the equivalent of 460,000 gal of fuel oil or 3,000 tons of coal—the Nautilus will be able to cruise around the world without refueling.

The launching, at the yards of the Electric Boat Division of the General Dynamics Corp., at Groton, crowns a project initiated by the Navy and the Atomic Energy Commission in 1948 and directed by Rear-Admiral H. G. Rickover. In August 1951, the original Westinghouse-AEC contract for the building of Mark I was supplemented to include construction of Mark II, the actual Nautilus reactor, which is being assembled in the submarine hull.

Engineers Honored by Highway Research Board

Four engineers received awards from the Highway Research Board for achievements in their fields during the Board's recent 33rd annual meeting in Washington, D.C. Prevost Hubbard, Aff.ASCE, former chemical engineer for the Asphalt Institute, and Charles R. Waters, district engineer for the New York State Department of Public Works, were given the Roy W. Crum Award for Distinguished Service. The award, which honors the late ASCE Director Roy W. Crum, is made annually for "outstanding achievement in the field of highway research." Both recipients have been associated with highway research—Mr. Hubbard for almost 50 years and Mr. Waters for more than 25 years.

The Highway Research Board Award, given annually for an outstanding technical paper, went to Earl C. Sutherland, M. ASCE, and Harry D. Cashell, for their paper on "Structural Effects of Heavy-Duty Trailer on Concrete Pavement," which was presented at last year's annual meeting of the Board and published as Special Report 14 of the organization. Both are engineers with the U.S. Bureau of Public Roads. The award-winning paper deals with a special investigation conducted in connection with the Board's Road Test One-Md.

More than a thousand highway experts from the United States and foreign countries attended the meeting and heard papers and reports on research in the fields of highway design, construction, maintenance, finance, administration, soils and foundations, traffic, parking, and related problems.

$750,000 Traffic Study to Be Made in New York Area

Evidence of the need for additional trans-Hudson capacity is apparent in this aerial view, showing traffic backed up at the New York portal of the Lincoln Tunnel.

The traffic, which is strangling commerce in the metropolitan New York area, is to be restudied on a major scale. With the blessing of the Governors of New York and New Jersey, and the Mayor of New York City, the Port of New York Authority and the Triborough Bridge and Tunnel Authority are jointly undertaking a $750,000 comprehensive study of all phases of the arterial traffic problem in the area. It is expected that the study will be completed by October 1954. Working jointly for the first time, the two agencies are hoping to develop a plan for the construction of river crossings, connecting highways, local expressways and parking facilities incidental to these projects for the years immediately ahead. The program will include:

1. A new study of the Narrows Bridge between Brooklyn and Staten Island to facilitate the development of the Borough of Richmond and to provide a bypass route south of Manhattan for New Jersey–Long Island traffic, and for through traffic moving between the South and West and New England. This study will cover expressway and parkway connections with the Gowanus Improvement in Brooklyn, the Long Island parkway and expressway system, and across and along Staten Island to the three Port Authority bridges leading to New Jersey.

2. A lower level for the George Washington Bridge to provide new lanes of vehicular traffic, combined with new and expanded approaches on both sides of the Hudson and over the Harlem River, to accommodate the increasing traffic moving between New Jersey and East Bronx, lower Westchester, Queens and Long Island points. In the original design of the George Washington Bridge, provision was made for a second level below the existing roadway. An immediate study will be undertaken of the addition of this second level for new lanes of vehicular traffic.

3. A possible new bridge spanning the Hudson River in the general vicinity of 125th Street, Manhattan, integrated with the Triborough Bridge crossings of the Harlem and East rivers and the East and Harlem River drives in New York, and with appropriate arterial highways in New Jersey.

4. Review of the need for trans-Manhattan vehicular facilities (Lower Manhattan Crosstown Expressway and the 30th Street Expressway) for local traffic in the light of the possible new bypass routes across the Narrows and upper Manhattan for through traffic between New Jersey and Long Island. A study will also be made of the physical and economic practicability of a 30th Street crosstown tunnel as an alternative to an elevated expressway.

5. As an integral part of the joint studies of major bridge and approach facilities and other arterial highways, all studies having to do with approach highways and expressways will include recommendations as to the possibility of off-street parking facilities either beneath the elevated expressways or on independent sites adjacent to the expressways. The study will also include an exploration of possible peripheral parking facilities in the outlying areas of New York City and in the State of New Jersey.

Consultants retained by the two agencies include: Madigan & Hyland; Edwards, Kelcey & Beck; Ammann & Whitney; Andrews, Clark and Buckley; Coverdale & Colpitts; and Fay Spofford and Thorndike.

Major projects to be studied by the Port of New York Authority and the Triborough Bridge and Tunnel Authority are indicated by heavy dark lines. An estimated 385,000,000 vehicles, entered, left, or passed through Manhattan in 1953. Of these 73,000,000 crossed the Hudson River. It is estimated that the latter figure will reach 95,000,000 by 1960.

Army Engineers Complete 190 Military Projects

Completion of 190 millitary jobs, totaling $145,098,108, within the United States during the 1953 fiscal year is reported by the Army Corps of Engineers. Undertaken for the Army, the Air Force, the General Services Administration, and the Veterans Administration, the jobs included barracks, warehouses, plants, hospitals, the expansion and improvement of air bases, and other construction. Still in progress at Army and Air Force installations at the midpoint of the 1954 fiscal year are 4,045 similar jobs with a total construction cost of $2,130,291,000. These figures do not include extensive work under way in overseas areas.

Construction contractors received 93.4 cents of each dollar that went into the jobs completed in the 1953 fiscal year, according to Maj. Gen. S. D. Sturgis, Jr., Chief of Engineers. He noted that design and field supervision costs came to 4.5 percent of the total cost, "a figure that compares favorably with the usual fee of 6 percent paid by private companies for similar services." General overhead costs were also low, totaling 2.1 cent of each dollar spent.

ASTM Starts Wood Pole Research Program

A two-year research program, which is expected to save industrial users millions of dollars in pole costs by establishing more precisely the breaking strength of wood poles, has been started by the American Society for Testing Materials. A fund of $150,000 is being raised to finance the work, and industries that produce, treat, and use poles have allotted sufficient funds to justify a start. Research is being conducted at the U.S. Forest Products Laboratory, Madison, Wis., under the supervision of a technical committee headed by R. P. A. Johnson.

Building Construction Code For Multiple Dwellings

Rules and regulations for all types of residential building are established by the New York State Building Code Commission in a recently completed *State Building Construction Code Applicable to Multiple Dwellings*. The code augments the one- and two-family dwelling code previously promulgated.

The significance of these residential regulations is twofold, the commission notes: "(1) They represent completion of pioneering code-writing work under the 'performance standards' mandated by the legislature through the State Building Code Law, and (2) they provide all municipalities of the state, at their option, with rules and regulations covering 88 percent of all new projects on which permits are issued (percentage based on construction records for the first ten months of 1953)."

The remaining 12 percent of construction projects represented by non-residential building will be covered by the third portion of the code now in preparation. Edward J. McGrew, Jr., is chairman of the State Building Code Commission.

Inquiries concerning the multiple-dwelling code should be addressed to the State Building Code Commission, 1740 Broadway, New York 9, N.Y.

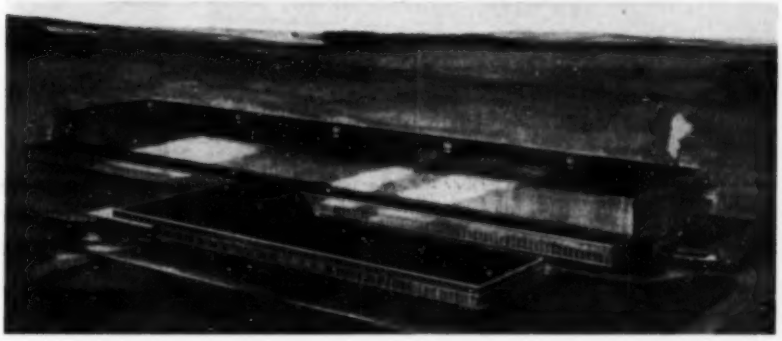
Steel Industry Expands Plant Capacity in 1953

Iron and steel companies spent more than $1 billion to expand and improve their plants in 1953, according to an announcement from the American Iron and Steel Institute. With this outlay, the third largest in the history of the industry, over $5.6 billion has been invested by the companies for new equipment and construction during the eight postwar years, 1946 to 1953. Nearly all of the expansion and improvement has been privately financed.

Facilities going into operation during the year included about 500 new coke ovens and more than 400 rebuilt ovens; several new blast furnaces; steelmaking furnaces; soaking pits; a new seamless tube mill; equipment for rolling sheets, strip and tin plate; a new bar mill; and annealing equipment.

At the start of 1954, the annual steel capacity of the country was 124,330,410 net tons of ingots and steel for castings—the highest level ever achieved and an increase of 6,782,940 tons during 1953. The industry's new annual capacity represents an increase of more than 32,000,000 tons, or 35 percent, in the eight postwar years, and a gain of more than 52 percent since 1940.

Westinghouse Builds Atomic Equipment Plant



Engineering and other office personnel are moving into this new plant of the Westinghouse Atomic Equipment Department. Located in Harmar Township, near the Allegheny Valley Interchange of the Pennsylvania Turnpike, the plant is part of the Westinghouse Atomic Power Division, which is building the atomic submarine engine for the U.S.S. Nautilus and developing the first civilian atomic power plant. The new plant will produce component parts and accessories for atomic power plants and represents a $2,000,000 initial investment by the company.

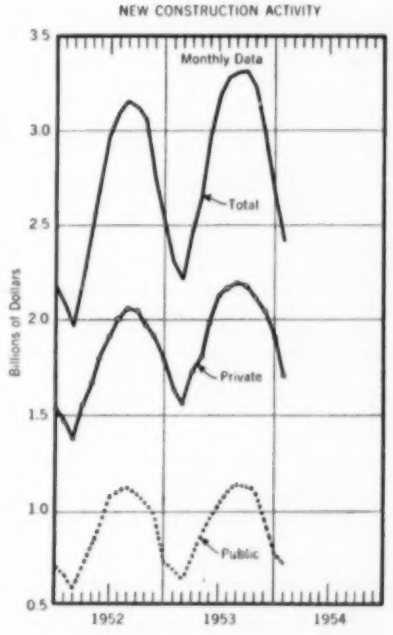
January Construction Expenditures at Record High for the Month

The total value of new construction put in place during January 1954 amounted to more than $2.4 billion, a 9 percent decline from December, but 3 percent above January a year ago, according to preliminary estimates of the Building Materials and Construction Division of the U.S. Department of Commerce and the Labor Department's Bureau of Labor Statistics. Activity was at near record levels in January after allowance for seasonal factors. Private industrial building advanced contraseasonally during the month, while most other major types of work showed the decline that is usual for January.

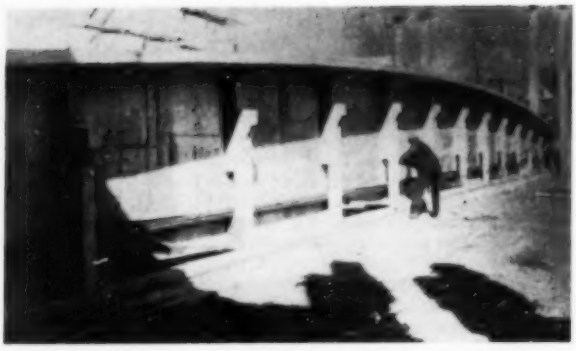
Private expenditures were at record January levels for new commercial, religious, and educational building and for public utilities, as were public expenditures for schools, highways, and sewer and water construction.

Total private spending for new construction in January amounted to $1.7 billion, down 10 percent from December but 5 percent above the January 1953 figure. The value of new work on private residential building declined a little more than seasonally to $825 million, about the same outlay as for January a year ago. Private industrial building, after holding steady for the four previous months, showed an increase in January mainly because of activity on large projects begun late in 1953. However, the level of January 1954 expenditures for private industrial plant was about 10 percent under January 1953.

Total public spending for new construction declined 5 percent in January to $712 million, trailing the January 1953 estimate by 3 percent. Expenditures were at a lower level this January than a year ago for all major types of public construction except schools, highways, and sewer and water construction.



New construction put in place in January comes to more than $2.4 billion—an increase of 3 percent above the January 1953 construction total—as shown by Department of Commerce curves.



One of the important applications of prestressed concrete in Canada is the Memorial Center at St. Thomas, Ont., designed by Philippe A. Benn, of Pre-Compressed Concrete Engineering Co., Ltd., according to the Magnel system. This building, 133 by 228 ft, required ten beams of 136-ft clear span supported 27 ft above ground. The long beams are of I-section with a top flange 42 in. wide and a bottom flange 24 in. wide and heights varying parabolically from 4 ft 6 in. at the ends to 8 ft 4 in. at the center. For prestressing, a 64-wire cable outside the thin web was passed through stiffeners on each side of the web and, after tensioning, was grouted and bonded to the beam. Both were raised into place atop their columns by jacking devices. These 90-ton beams are said to be the longest prestressed concrete beams in America. Photos courtesy of the Engineering Institute of Canada and Mr. Benn.

Prestressed Concrete Experts Confer in Toronto

Skeptics and enthusiasts—450 of them—assembled at the University of Toronto late in January for a three-day Conference on Prestressed Concrete under the auspices of the University Extension Division. Though the conference was primarily intended as a review of this modern construction method for Canadian engineers, it proved widely popular, with engineers in attendance from Belgium, England, France, Venezuela, India, and Australia. That the desire for more practical knowledge in the field is great is indicated by the fact that probably no more than 5 percent of those in attendance are actively engaged in actual design and construction of prestressed concrete structures.

The nine major conference papers, with illustrations by authorities in the field, are already available in a paper-bound volume that sells for $2.50 (Canadian money). Inquiries with remittances should be sent to the Extension Division of the University of Toronto, Toronto 5, Canada.

In answer to the question, "Why Should We Use Prestressed Concrete," R. F. Shaw, vice-president of the Foundation Company of Canada, said that the new product must show an economic advantage; that "it's high time we have a code"; that we must learn more about bond between wires and concrete, and more about end anchorages; and that construction procedures must be simplified particularly in continuous beam work.

Conclusions drawn by A. T. Waidelich, M. ASCE, vice-president and engineer of research for the Austin Co., Cleveland, Ohio, after several years of study, testing, and construction, were that there are attractive potentialities for prestressed concrete in such long-span structures as hangars, arenas, auditoriums, and parking garages. Post-tensioned construction becomes more economical than ordinary reinforced concrete for spans of from 40 to 60 ft or more, depending on the magnitude of the live load. Mr. Waidelich commented that, although the theory of prestressed concrete is not new, application of it on the American continent is in its infancy. He forecasts for it a vigorous future, especially as time and experience point the way to economic balance between the cost of the materials and forms and the field labor required.

A concise review of the fundamental theories underlying the present development of prestressed concrete was given by Harold Fealdman, research engineer for the Hydroelectric Power Commission of Ontario (HEPC). R. B. Young, concrete consultant for HEPC, said that the success of prestressed concrete construction "depends on uniformly good concrete for every part of every member of the structure," even more than does the success of ordinary reinforced concrete. He also emphasized the necessity for "close and constant supervision of every phase of concreting."

M. W. Huggins, A. M. ASCE, assistant professor of civil engineering at the University of Toronto, reviewed the types of steel desirable and available for prestressed concrete, and advanced tentative steel specifications. He raised a red flag of warning against the possibility of stress corrosion in certain kinds of wire, particularly under higher stresses.

In speaking of allowable working stresses, Prof. Gustave Magnel, M. ASCE, of the University of Ghent, recommended for steel wire of 5-mm dia stresses of 144,000 psi, and for 7-mm wire stresses of 130,000 psi. For concrete, strengths of 4,500 psi, at 14 days (prestressing time), and 6,600 psi, at three months, are obtainable under practical field conditions, Professor Magnel said. The allowable stress at prestressing time (14 days) is then 2,000 psi and 2,200 psi under working conditions. "If prestressed concrete is economical only when we use absurd working stresses, then let us drop it," he advised.

Speaking of codes for prestressed concrete, A. E. Cummings, M. ASCE, director of research for the Raymond Concrete Pile Co., expressed the opinion that we are not yet ready for a compulsory design code, and that developmental work must be continued. In the meantime, a joint 75-man task committee of the American Concrete Institute and ASCE is preparing a Manual of Recommended Practice for Prestressed Concrete.

Attention to the sequence in building erection and in prestressing the system can result in important design savings, according to T. O. Lazarides, structural consultant of Toronto. Dr. Lazarides' contention that "statical indeterminacy is the foundation of prestressed concrete design" met with wide disagreement by discussers who maintained that the design of prestressed concrete is simple and not as indeterminate as reinforced concrete.

Reporting on research, A. L. Parme, A.M. ASCE, of the Portland Cement Association, Chicago, stated that "few new structural developments have been accompanied by as much research as prestressed concrete." A striking fact emerges from these tests, namely, that there is close agreement between predicted and experimental values up to the cracking load. Since cracking load is generally higher than design or service load, he concluded that little uncertainty exists about the performance of prestressed concrete under service load. Some unanswered questions include magnitude of creep, friction developed between concrete and draped cables during tensioning, and bond between wires and concrete.

A panel of authorities answered questions from the audience in a lively discussion of phases of design and construction. The panel consisted of Robert Shama, M. ASCE, of Venezuela; Yves Guyon of Paris; Gustave Magnel, M. ASCE, of Brussels; James Mennis of San Antonio, Tex.; T. O. Lazarides of Toronto; and E. P. Muntz

consultant for HEPC. Dean Kenneth Tupper was moderator. Mr. Shama gave a well-received lecture at a joint meeting of the Royal Canadian Institute and the Toronto Branch of the Engineering Institute of Canada at Convocation Hall, University of Toronto, to which those attending the conference were invited. He described the construction of three prestressed concrete-arch bridges he has recently completed on the route of the 10.8-mile superhighway in Venezuela that connects the sea port of La Guaira with Caracas.

Much credit for the organization of the constructive three-day conference goes to a committee of ten headed by C. E. Morrison, professor of civil engineering at the University of Toronto.

Mapping Experts Have Twentieth Annual Meeting

Photogrammetry in engineering, in civil defense, and in numerous other applications was studied at the twentieth annual meeting of the American Society of Photogrammetry, held in Washington, D.C., January 13–15. The keynote and opening address was given by Ralph A. Tudor, M. ASCE, Undersecretary of the Department of the Interior, who said that aerial mappers are helping the government do a better job of managing and developing our national resources. His subject was "Photogrammetry in Resources Development." In a paper on "Aerial Photography in Civil Defense," William T. Walsh, Jr., of the U. S. Library of Congress, reported that aerial photos are being relied upon by the Federal Civil Defense Administration "in marshalling forces to counteract a possible large-scale, devastating attack on this country by a potential enemy."

Speakers in the panel covering engineering applications included C. M. Cottrell, vice-president of Fairchild Aerial Surveys, Los Angeles, whose subject was "The When, Where, How, and Why of the Engineering Application"; Louis A. Woodward, vice-president of Jack Amman Photogrammetric Engineers, San Antonio, who reported photogrammetry in city planning operations; William T. Pryor, A.M. ASCE, of the Bureau of Public Roads, Washington, who presented highway applications; L. A. Dickerson, M. ASCE, of Lockwood, Kessler & Bartlett, Great Neck, N. Y., who discussed the integration of photogrammetry with engineering surveys; Bernard H. Kock, of the Cincinnati Department of Public Works, who spoke on photogrammetry as the key to the engineering planning of his city's metropolitan area; and David A. Warnick, J. M. ASCE, connected with Michael Baker, Jr., Inc., Rochester, Pa., whose subject was "Application of Photogrammetry to Small Engineering Projects." Moderator for the panel was J. T. Pennington, of the Engineer Research and Development Laboratories at Fort Belvoir.

Another panel session focused attention on the economies made possible by photogrammetry. The moderator was Walter G. Stoneman, of the Foreign Operations Administration, Washington. A seven-member panel, moderated by David Landon, of the U. S. Geological Survey, Washington, dealt with research applications.

The attendance of 700 included photogrammetrists from Canada, Latin America, Europe, and Asia. Bertil P. Hallert reported plans of the International Society of Photogrammetry for the eighth quadrennial meeting to be held in Stockholm, Sweden, in 1956. Developments in international research were described by Capt. O. S. Reading, of the U. S. Coast and Geodetic Survey.

Arthur C. Lundahl, of Bethesda, Md., was installed as 1954 president of the society at its first business meeting. Other new officers are W. Sidney Park, of Louisville, Ky., first vice-president, and Robert N. Colwell, of Walnut Creek, Calif., second vice-president. C. Earl Palmer will continue as secretary.

Arthur C. Lundahl (left), newly elected president of American Society of Photogrammetry, is shown with Ralph A. Tudor (Center), M. ASCE, Undersecretary of the Interior and key meeting speaker, and A. O. Quinn, M. ASCE, retiring president.

1953 Housing Starts Remain at Record High

Housing starts in 1953 exceeded the million mark for the fifth consecutive year, when 1,102,400 new permanent non-farm dwelling units were put under construction, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics. The total was only 2 percent under the final estimate of 1,127,000 for 1952—the second best housing year on record—with virtually all the decline from 1952 in public housing. The all-time peak of 1,396,000 starts occurred in 1950.

Privately owned new housing in 1953 totalled 1,066,900 units, about the same number as in 1952. Seasonally adjusted, the annual rate of private starts in 1953 exceeded 1.1 million units during five months of the year (including December), and was above a million for all months except August, when activity was adversely affected in some areas by work stoppages. In contrast, new public housing dropped by 39 percent from 1952 to 35,500 units, the lowest volume in five years.

Although housing starts in 1953 declined almost steadily from the peak in April, the rate of decline in the closing months of the year was less than seasonal. An estimated 68,000 units were begun in December, 12,000 less than the November figure and 3,500 less than in December 1952. Early reports to the Bureau indicate that the 1953 November-December decline in private housing occurred in sections of the country that were most affected by the onset of winter weather, particularly the North Central States.

Pennsylvania Turnpike Maps Its New Extension

The route of a 100-mile section of the Northeastern Extension of the Pennsylvania Turnpike has been announced by the Pennsylvania Turnpike Commission. Starting near Plymouth Meeting on the Delaware River Extension in Montgomery County, the first section will extend north through the Allentown-Bethlehem metropolitan area, terminating at Moosic in the Wilkes-Barre area.

Aimed at developing the industrial potential of the hard coal region, the Northeastern Extension will also serve the Pocono Mountain resort area. Ultimately the extension—the first north-south leg on the turnpike—will be carried to the New York State border at a point near Binghamton for possible connection with the New York State Thruway.

Ground-breaking ceremonies for the new section are scheduled for the end of February, with construction to begin early in March. The 33-mile Delaware River Extension, now under construction, is scheduled for completion in October. Completion of both extensions will give the state a 460-mile superhighway system.

Preassembled Building Provides Huge, Unobstructed Floor Space at Low Cost

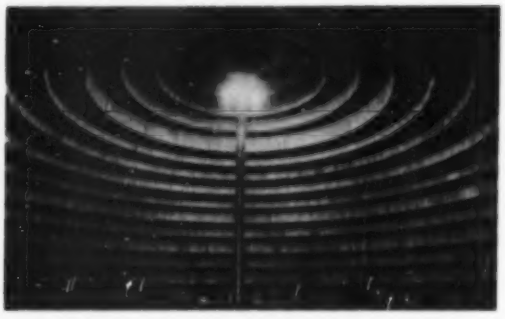
Pointing the way to new design and construction techniques is a huge, dome-shaped building, with seating capacity of 12,000, just completed at Longview, Tex. Assembled at ground level, the 85-ft-high, 310-ft-dia, steel and aluminum building provides 70,686 sq ft (about 1.6 acres) of clear floor space without structural supports. Though a steel center pole, 94 ft high, is used in erection of the building, it is not necessary for support of the completed structure and can be left up or not as desired. Only about 3,000 man hours were required for actual assembly of the building.

A product of R. G. LeTourneau, Inc., and called the LeTourneau Semisphere, the structure was built adjacent to the company's plant and corporation headquarters at Longview. Similar buildings can be erected anywhere with prepared metal parts shipped to the building site. The cost of such buildings, completely erected, is said to be less than $4 per sq ft of space afforded.

The LeTourneau semisphere is put together from the top down, though the actual work of assembly and building is done on the ground. Installation of the steel center pole, which is required for erection, is a necessary preliminary. The pole is bolted to a steel and concrete foundation, and raised by a long-boom crane. Before it is put up, a cone-shaped aluminum hood, which controls an opening for ventilation at the peak of the completed Semisphere, is attached to the top of the pole.

After the center pole is in place, a sliding steel collar, called the peak structure, is gradually raised up it by electric winch, as 15 successive rings of aluminum sheets are bolted on. A 36-in. drum, located at the base of the pole, handles the cable that raises the entire dome as it is assembled. Jackstands steady the bottom edge of the partially constructed dome during the attaching of each new ring of sheets. When the last ring is bolted on, the peak structure is 85 ft up the center pole. The lower edge of the completed building is then lowered and firmly secured to a foundation of concrete, poured in advance to accommodate the circumference of the building. Ventilation is provided by a 255-sq ft opening through the peak around the center pole. A small winch elevates and lowers the aluminum hood that controls the ventilation opening. The structure is designed for snow and wind load capacity of 40 psf.

When delivered to buyers, the LeTourneau Semisphere consists of the aluminum sheets—curved, embossed, flanged, and drilled—and all other necessary aluminum and steel parts produced to the company's design specifications. Dimensions of the aluminum sheets are 7 by 12½ ft by ¼ in. thick.



In top view a long-boom crane prepares to raise the 94-ft erection pole. The cone-shaped aluminum hood, which controls ventilation of the completed structure, is being attached to the top of the pole before it is raised. An acre and a half of unobstructed interior space is provided by the Semisphere Building (center). Concentric rings of acoustical material have been suspended from the ceiling of the dome for sound control. A 75,000-w lighting installation is shown near the top of the center pole.

Some idea of the huge size of the LeTourneau Semisphere Building, shown here in aerial view, may be obtained from comparison with automobiles and nearby homes of plant employees. The cone-shaped hood at the peak of the dome controls the ventilation of the building.

Contract Let for Piers For Newark Bay Bridge

Construction of 20 piers for the mile-long river crossing of a bridge on the New Jersey Turnpike Extension over Newark Bay is one of the major projects scheduled for 1954 by the Contracting Division of the Dravo Corp., of Pittsburgh. The company's bid of $3,934,250 was the lowest of five received for the job by the New Jersey Turnpike Authority. The Newark Bay-Hudson County Extension will carry express traffic from the Newark Airport interchange of the turnpike, eight miles to the Holland Tunnel Plaza in Jersey City.

Each pier will be built in a steel sheetpile, single-skin cofferdam. Foundations will be supported by steel bearing piles driven to rock. The piers vary in height, with the tallest 122 ft above normal water level. The foundations of the largest pier will be 124 ft long, 60 ft wide, and 50 ft below water. The lower portion of each pier will be constructed by underwater concreting.

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This remarkably graphic model shows both the topography and the geological features of the area. It is formed in sturdy Vinylite, measures 58 x 31 inches and weighs less than 2 pounds. It is being used by the Iron Ore Company of Canada in planning its Ruth Lake-Fleming development. Identical copies hang in the offices of the company, as well as in the offices of partners of the Iron Ore Company, including the M.A. Hanna and Hollinger Companies.

Basic topographic information for the model was taken from aerial topographic maps made earlier by Canadian Aero Service, our affiliate, from photographs available for the area. Geologic data was provided by the Iron Ore Company of Canada.

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R. ROBINSON ROWE, M. ASCE

The Engineers Club of Esseyeville was impatient to discuss final plans for the convention late in April. Someone moved to lay Professor Neare on the table, but he raised a point of order and promised to be quick. "In fact," he said, "I'll be quicker if Joe solved the isoscelezium problem.

"There was a trapeze, you remember, with a 3-ft bar on 3-ft ropes hooked 6 ft apart, and the bar dipped because Jim Nast on one end weighed one-third as much as his dad on the other, and I asked . . ."

"How much higher one end was than the other," finished Joe Kerr. "I got 3 ft."

Cal Klater guffawed, but the Professor shushhhhed and asked, "How?"

"By a full-scale model," answered Joe defiantly. "I had a little trouble with the statics equations and a little more trouble with a graph, so I built a trapeze. I weigh 183 and my boy, Stinson, only 50, so I hung Stin and 2 horseshoes on one end and chinned myself on the other. The shoes slid to my knuckles; I reacted and broke the rope, then landed on the hard side of the floor with one horseshoe around my neck and Stin on my solar plexus. My end of the bar was exactly 3 ft lower than the other!"

"Sorry I missed it," laughed Cal callously. "Joe's equations were probably:

$$\sin A - \sin B - \sin C = 0 \quad (1)$$
$$\cos A + \cos B + \cos C = 2 \quad (2)$$
$$\tan A - 3 \tan B + 4 \tan C = 0 \quad (3)$$
$$3 \sin C = x \quad (4)$$

which lead to a bi-sextic in x with large coefficients. Since C is small, I made a guess, solved (1) and (2) for A and B, then (3) for C, which became my second guess. I converged rapidly on $x = 0.558$ ft."

"Admittedly correct, but I'm disappointed," said the Professor. "Such a simple-looking problem should have a simpler dénouement. However, you can get a sextic in cos C, or better yet, let vers $C = u$ and find

$$256u^6 - 512u^5 + 160u^4 - 480u^3 + 45u^2 - 58u + 1 = 0 \quad (5)$$

Since u is small, we can neglect the higher powers and get the approximation $u = 1/58$, $x = 3\sqrt{115/58} = 0.555$. Horner's method applied to (5) gives more precisely $x = 0.55773\ 56208$. Easier, altho sounding more complicated, is a contraption invented by Guest Professor M. T. Tank."

"I call it the 'jet inhibitor'," said Professor Tank. "Duplicate standpipes, A and B, of constant section, 36 ft high and full of water, stand side by side with horizontal ideal orifices facing each other at the bottom and controlled by inside plate valves. A flat disk is constrained between the orifices, centered with and normal to their common axis but free to move along it. The valve of A is opened and the effluent jet forces the disk against the orifice of B. A minute later when stage in A had dropped 5.75 ft, the valve of B was opened. When were both A and B drawn down below the 4-ft mark?"

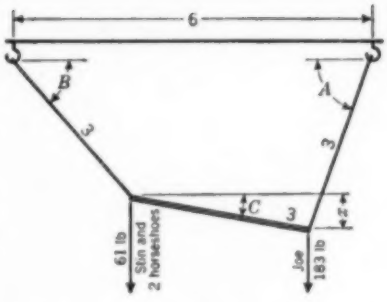


FIG. 1. Joe's isoscelezium model; he learned the hard way that $x = 3$

[Cal Klaters were Stoop (John L.) Nagle, Ed. C. Holt, Jr., Ignor Antenuff (Paul Hartman), Flo Ridan (Charles G. Edson), Walter Tudor, Return Moore, Sauer Doe (Marvin Larson), O'Kay (Otto Koch) Don't (Donald Thayer), G. I. (Morton) Raff, and Rudolph W. Meyer. Guest Professor Tank is Julian Hinds. Also acknowledged are solutions to the spherometer from Cacosfboe (Valentine Padovan), Emerson J. Boyd, Jr., and Thatchrite (Guy C. Thatcher).]

Novel machine Lays Base Course Without Forms

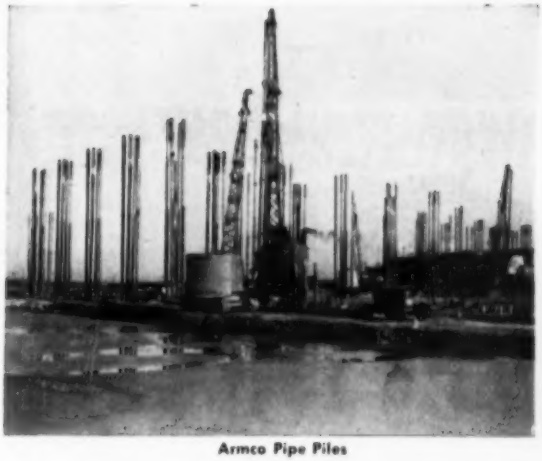
A machine for laying pavement without forms—specially developed by a contractor for use on an Illinois Division of Highways project in Franklin County, where the specifications permitted building the base course without forms as an alternate to building it with forms—is described by Robert H. Tittle, M. ASCE, engineer of construction for the Division of Highways. The unit (shown in the accompanying photos) was used for the construction of about three miles of 24-ft-wide concrete base course, 9 in. thick, upon which was placed a bituminous binder and surface course 3 in. thick.

The machine, which is still in the developmental stage, laid as much as 1,040 lin ft of base course in nine hours. Throughout the work it operated without any mechanical failure. An extremely regular edge alignment was obtained, and the edges stood vertically after the machine passed forward. In addition, the surface finishing was uniform. Operating speeds varied from 3 to 5 fpm. The machine was developed by the Regenhardt Construction Co., of Cape Girardeau, Mo.

Experimental machine (front view at immediate left) lays 24-ft base course, of 9 in. uniform thickness, without forms on Illinois Division of Highways project in Franklin County. Back view of unit is shown in top photo.

(Vol. p. 196)

Here's Foundation Pipe for Every Need

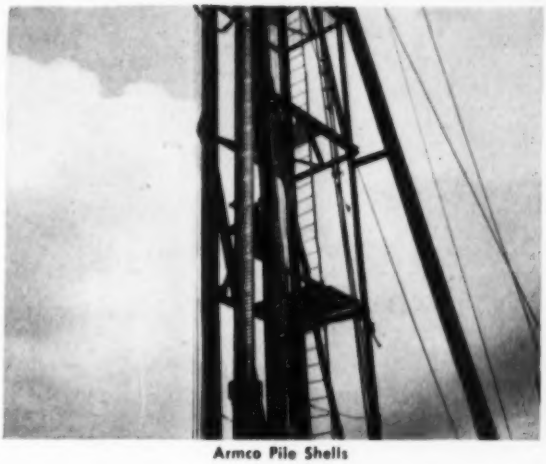


Armco Pipe Piles

Most foundation pipe jobs are different. But with the wide selection of Armco Pipe Piles, Pile Shells and Caissons—it's easy to find the foundation pipe that meets your requirements exactly.

ARMCO PIPE PILES are of spiral-welded fabrication. They offer high collapse resistance; unusually great beam strength for straighter driving; constant cross-section for maximum end-bearing in good strata; and uniform diameter that permits salvaging cut-offs. Pipe piles are available with mill-attached plate ends, cone points and cutting shoes.

SIZES: Diameters range from 8⅝" to 22", O.D. Wall thicknesses from .141- to .500-inch. Standard lengths up to 60 feet. Longer lengths available.



Armco Pile Shells

ARMCO HEL-COR PILE SHELLS have helical corrugations and a continuous lock-seam. They are easily handled, light in weight, extremely straight, uniform in diameter and watertight. Cut-offs can be salvaged by field welding. Armco Pile Shells are widely used for Cobi mandrel-driven or drop-in shells and for the top portion of composite piles.

SIZES: Diameters range from 8⅝" to 22½", O.D. Wall thicknesses from 18 to 14 gage. Lengths up to 60 feet.

ARMCO CAISSONS are of the same spiral-welded manufacture as Armco Pipe Piles. The principal difference is in larger diameters and heavier wall thicknesses. They meet the most severe requirements in driving and loading, and have been proved under the most difficult conditions.

SIZES: Diameters range from 24" to 36". Wall thicknesses are from .375- to .500-inch. Standard lengths range up to 70 feet.

Armco Caissons

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ARMCO

Fewer man-hours on the job!

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for round columns of concrete

Sonotube Fibre Form being placed in position during construction of Pierce and Phelps Co. building, Philadelphia, Pa. Robert E. Lamb Company—contractors.

(photo by E. Troiani)

SONOTUBE Fibre Forms for concrete columns take fewer men to handle because they are lightweight . . . take less time to erect because they require minimum bracing.

Widely used and approved by contractors, engineers and architects everywhere, SONOTUBE provides a fast, economical method of forming round columns of concrete for a multiplicity of structures.

SONOTUBE forms can be supplied in specified lengths or sawed to your requirements on the job. In 31 sizes, from 1" to 36" I.D. up to 24' long. Longer on special order.

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DECEASED

George Scott Baton (M. '20), age 84, mining engineer and coal consultant, died in Pittsburgh, Pa., on December 28. Mr. Baton was a partner in the Pittsburgh consulting firm, George S. Baton and Co., which built more than 40 mining installations and plants. He was also chairman of the board of the Greensburg-Connellsville Coal & Coke Co., and the Baton Coal Co., which operated five mines in Pennsylvania, West Virginia, and Ohio.

Robert Morris Brooks (A.M. '42), age 44, since 1949 manager and partner in the Oliver Metal Screen Co., of Atlanta, Ga., died on December 17. Before locating in Atlanta, Mr. Brooks served for 12 years with the Department of Interior's Indian Service at Muskogee, Okla. Earlier he was connected for brief periods with the Oklahoma and Arkansas state highway departments, the Bureau of Public Roads, and the U.S. Engineer Department. Mr. Brooks graduated from Oklahoma A & M College in 1931.

Leon George Cutler (A.M. '13), age 71, retired engineer of Nutley, N.J., and an alumnus of Tufts College, died in Nutley on September 30. Connected with the New York Board of Water Supply from 1909 to 1912 and from 1936 until his retirement in 1948, Mr. Cutler was engineer in charge of design for the Merriman, Neversink and Downsville dams of the Delaware Water Supply System, and department engineer at the Board's headquarters in New York City. In the latter capacity he initiated construction on the Second Stage of the Delaware Water Supply System. For much of the intervening period he was with the North Jersey District Water Supply Commission engaged on design of the Wanaque Reservoir and other major structures. He served in the Army in World War I.

Burton Fremont Dinsmore (M. '39), age 64, since 1937 consulting engineer of Alhambra, Calif., died at his home in Pasadena on January 11. After graduating in 1912 from the University of Utah, he was office engineer for two years with William J. Moran of Salt Lake City. From 1914 to 1936 he was manager and vice-president of C. F. Dinsmore & Co., at Ogden.

John Ellis Field (M. '08), age 86, retired engineer of Denver, Colo., died in that city on January 12. He received a civil engineering degree from Yale University in 1888. Mr. Field had been engaged in private practice from 1892 to 1895, 1903 to 1933, and 1947 to 1950. Intermittently he served as the second State Engineer for Colorado, and worked for the Public Works Administration, the Defense Plant and War Plants corporations, and the Bureau of Reclamation.

Samuel Gordon (M. '30), age 70, for the past two years consulting engineer with the North Jersey District Water Supply

Commission at Wanaque, N.J., died on October 30. Earlier (1923–1943) Mr. Gordon was assistant and senior assistant engineer for the Commission at Newark. He graduated from the U.S. Naval Academy in 1905 and served in the Civil Engineer Corps on assignments that included direction of engineering work at Pearl Harbor. He retired in 1921 with the rank of lieutenant commander. In World War II he worked at the Navy headquarters in New York City with the rank of full commander (retired).

Nicholas Hunter Heck (M. '23), age 71, who retired in 1945 after 41 years of service with the U.S. Coast and Geodetic Survey, died in Washington, D.C., on December 21. For more than 20 years Captain Heck was chief of the Division of Terrestrial Magnetism and Seismology (now the Division of Geophysics) and at the time of his retirement was scientific assistant to the director of the Bureau. An authority on seismology, he was the author of a volume on earthquakes. He also developed an electronic technique which revolutionized methods of ocean surveying, and made important contributions to the development of the wire-drag method of finding obstructions to navigation. Captain Heck was an alumnus of Lehigh University.

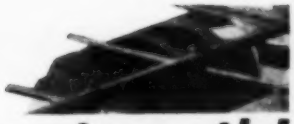
Cecil Blaine Hopkins (A.M. '18), age 70, founder and president of the Steelform Contracting Co., of San Francisco, Calif., died in that city recently. Prior to the establishment of the Steelform company in 1918, Mr. Hopkins was a structural engineer for the McClintic-Marshall Co., Pittsburgh, and the Truscon Steel Co., Detroit, and chief engineer for the Concrete Engineering Co., Omaha, and Pacific Coast manager for the firm in San Francisco. He was a 1907 graduate of Cornell University.

Theodore Julius Klossoski (A.M. '04), age 79, retired engineer of Calgary, Alberta, Canada, died on November 4. Practicing as a structural engineer—primarily in Calgary—for more than half a century, Mr. Klossoski specialized in the design and construction of cement mills and power plants. He was an alumnus of the University of Illinois, class of 1897.

John Alexander McNiven (M. '29), age 66, chief engineer for the Board of Commissioners of the Port of New Orleans for the past 24 years, died in New Orleans on January 18. Mr. McNiven joined the Board as assistant engineer in 1917, was promoted to principal assistant engineer in 1925, and became chief engineer in 1930. Prior to his connection with the Port, he did engineering work in Canada, Detroit, Chicago, and New York, and had extensive experience on construction of grain elevators.

John A. McNiven

(*Continued on page 100*)



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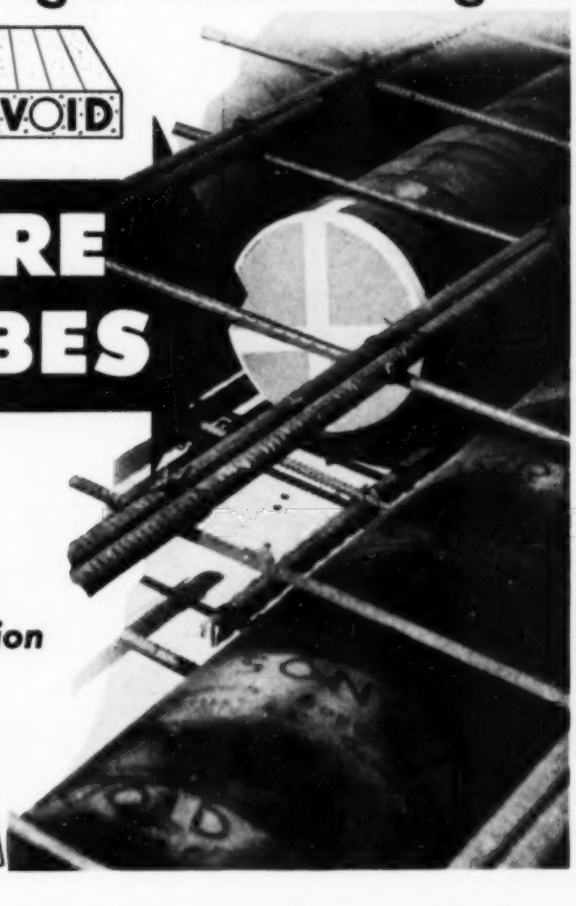
for voids in concrete construction



Sonovoid Fibre Tubes and reinforcing steel in place to receive concrete. Roof slab for paper mill surge tank.

SONOVOID Fibre Tubes form voids which reduce the weight of the slab without impairing structural strength. The low-working concrete at the neutral axis is eliminated.

Specifically developed for use in concrete roof, floor, wall and bridge deck slabs, low cost SONOVOID Fibre Tubes save concrete and reinforcing steel. And SONOVOID permits the prefabricating of prestressed and poststressed units.

SONOVOID Tubes can be supplied in specified lengths or sawed to your requirements on the job. Sizes from 2″ to 36.9″ O.D. up to 24′ long. Longer on special order.

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Contractor: C & C Construction Co.

BOTTOM UNSTABLE due to quicksand below subgrade. Photo shows collapse of steel sheet piling in this deep excavation for a Lift Station.

WELLPOINT SYSTEM—in new nearby site—solves problem perfectly as water is lowered the required 21 ft and digging speeds ahead by economical open-cut method.

THE soil mixture — clay, silt and fine sand — didn't make life any easier for the Griffin engineers, especially since subgrade, as noted, contained gravel and sand under artesian pressure. The results indicate efficiency of the planning and installation of system.

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Toronto Montreal Halifax

Deceased

(Continued from page 99)

Robert Hamilton Lee, Jr. (J.M. '51), age 30, engineer-in-training with the Ohio State Department of Highways at Columbus, Ohio, died early in January. Mr. Lee entered the department in June 1951, immediately following his graduation as a civil engineer from the University of Toledo.

Robert Vonartievelde Leeson (M. '13), age 81, associated for the past 18 years with the late W. W. Lane in the firm, Lane & Leeson, Phoenix, Ariz., died there on January 6. Previously Mr. Leeson had maintained a consulting practice in Los Angeles for 15 years. He was connected with the design of the Salt River Bridge between Phoenix and Tempe, the Rubidon Bridge across the Santa Ana River and 29 other bridges in the basin of the Santa Ana. He attended Cotner University at Lincoln, Nebr.

Thomas Alwyn Middlebrooks (A.M. '35), age 50, since 1937 chief of the Soils Branch, Engineering Division, Civil Works, Office of the Chief of Engineers, Washington, D.C., died in Alexandria, Va., on February 3, of a tropical disease contracted on a recent special mission for the French government in Africa. An authority on soil mechanics, Mr. Middlebrooks was active on the Soil Mechanics and Foundations Division's Committee on Earth Dams, and served as consultant on a number of large dam projects here and abroad. He was 1943 winner of the Society's James Laurie Prize for a paper on Fort Peck Dam and served as chairman of the U.S. Delegation to the Second International Soils Mechanics Conference in Rotterdam in 1948. He joined the Corps of Engineers at Vicksburg in 1928, following graduation from the Georgia School of Technology, and remained there until 1933. From 1933 to 1937, Mr. Middlebrooks was chief of the Soil Mechanics and Foundation Branch at Fort Peck Dam.

T. A. Middlebrooks

Roy Saxton Moore (M. '22), age 77, former civil engineer with the Public Works Division of the U.S. Navy Bureau of Yards and Docks at the Brooklyn Navy Yard, Brooklyn, N.Y., died on December 18. Mr. Moore, who had been at the Navy Yard for 13 years, was previously employed by the New York Department of Parks, the New York and New Jersey Bridge and Tunnel Commission, the Port of New York Authority, J. A. L. Waddell, Consulting Engineer, and Mason & Hanger Co., New York contractors. He was an alumnus of Pennsylvania State College.

Ralph Mallory Palmer (A.M. '23), age 68, assistant engineer for the City of Duluth, Minn., since 1917, died there on January 15. Entering the city's engineering department in 1915, Mr. Palmer remained there until his death. He was a World War I veteran and studied at Valparaiso University.

Leo Bond Roberts (M. '28), age 66, resident engineer with Skidmore, Owings & Merrill, New York, N.Y., died at his home in Port Washington, Long Island, on January 16. In the early 1930's Colonel Roberts was the leader of two expeditions sent by the J. G. White Engineering Corp., to make engineering surveys for a dam at Lake Tsana, Ethiopia. At various periods he was chief regional engineer for the WPA in the New England area, assistant chief engineer at the New York World's Fair, and worked for the U.S. Geological Survey, Wilbur Watson & Associates, Ravenna, Ohio, and the Curtiss-Wright Export Corp. in Chile. Colonel Roberts served in the Army Corps of Engineers in both World Wars. He attended the University of Kansas.

Hugh Adam Stoddart (M. '51), age 53, on the staff of the U.S. Bureau of Public Roads since his graduation from the University of Minnesota in 1924, died in Portland, Oreg., on December 20. He had arrived in that city ten days prior to his death to assume the duties of division engineer. During his career, Mr. Stoddart held assignments in Oregon, Montana and Alaska, advancing from junior civil engineer to division engineer for Alaska—a post which he held for the past five years.

Harvey Arthur Van Norman (M. '22), age 75, who retired in 1944 as general manager and chief engineer of the Department of Water and Power for the city of Los Angeles, Calif., died in that city on January 16. In 1907 Mr. Van Norman entered municipal service as supervisor of construction on the Owens Valley Division of the Los Angeles Aqueduct, and was in full charge of that project from 1913 to 1923. While on a two-year leave from the Department of Water and Power, he was consulting engineer to the Board of Public Works and city engineer. Mr. Van Norman returned to the water department in 1925 as assistant chief engineer and in 1929 became chief engineer. Active in Society affairs, he was a past-president of the Los Angeles Section.

John Fairfield Vaughan (M. '17), age 81, retired engineer of Belmont, Mass., and an alumnus of Harvard, died in Boston on December 17. Engaged in private practice from 1916 until his retirement in 1948 from the industrial engineering firm, Vaughan Engineers, of Boston, Mass., Mr. Vaughan specialized in the fields of hydroelectric power and public utilities. Prior to 1916 he was employed for fourteen years by the Stone & Webster Engineering Corp., Boston, and for brief periods by the New Haven & Hartford Railroad and the General Electric Co.

Harold Marshall Wakeley (J.M. '47), age 28, since 1947 vice-president of the building firm, the Wakeley Co., of Seymour, Conn., died in New Haven on December 7. He was a veteran of World War II. Mr. Wakeley graduated from the Yale University School of Engineering in June 1947. He served in the U.S. Army in 1951 and 1952.

Big Red TD 24 Power Play

Scores Against the Weatherman

An Actual Job Report from IH

CONTRACTOR PAUL CRAWLEY LANDS 800,000 CUBIC YARD CONTRACT ON NEW FLOODWALL FOR CAHOKIA CREEK DIVERSION CHANNEL ACROSS THE MISSISSIPPI RIVER FROM ST. LOUIS. BUT THE WEATHER DOESN'T WANT TO PLAY BALL...
I'M BEGINNING TO GET WEB FEET, PAUL, AFTER THREE WEEKS OF SPLASHING AROUND IN THIS RAIN!
THREE WEEKS OF IT! THREE WEEKS BEHIND SCHEDULE! WE'LL HAVE TO MOVE DIRT FASTER THAN WE EVER HAVE BEFORE.

APRIL RAINS FINALLY LET UP AND CRAWLEY GETS SET FOR A MUDDY KICK-OFF ON THE FIRST OF MAY...
I'M STAKING EVERYTHING ON YOU MEN MAKING UP LOST TIME! THERE'LL BE OVERTIME BONUSES FOR EVERYBODY! NOW LET'S GET ROLLING!

CONTRACTOR CRAWLEY AND MASTER MECHANIC RALPH DEVAULT COMPLETE THEIR PLANS...

EVERY MACHINE HAS TO WORK EVERY 10-HOUR SHIFT, RALPH! CAN YOU DO IT?
DON'T WORRY, CHIEF, THE OPERATORS ARE SHARING RESPONSIBILITY FOR THEIR RIGS WITH MY MECHANICS!

PAUL, THESE FOUR TD-24'S ARE THE ONLY CRAWLERS ON THE JOB THAT CAN BRING LOADS UP THIS SLOPPY INCLINE!
YES--THAT'S BECAUSE THEY CAN CLIMB AND STEER WITH POWER ON BOTH TRACKS, BUT THE OTHER CRAWLERS CAN'T!

HERE COMES YOUR PART, RALPH! HOPE I DIDN'T HOLD YOU UP!
WE'LL SLAP IT IN THE MINUTE YOU LAND, PAUL--AND THAT BIG RED BABY WILL BE HITTING 100% AT STARTING TIME!
INTERNATIONAL

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CRAWLEY PUSHES RIGHT THROUGH THE WET SEASON, AVERAGES AS HIGH AS 14,600 CU. YDS. ONTO THE LEVEE PER 10 HOUR SHIFT.
WE'VE CHECKED AND RECHECKED OUR MEASUREMENTS, PAUL, AND YOUR DIRT MOVING FIGURES ARE ABSOLUTELY CORRECT! I DON'T SEE HOW YOU DO IT WITH SO FEW MACHINES!
HERE'S HOW, INSPECTOR! 27-YARD HEAPED LOADS... FAST LOADING TIME ... AND TD-24'S THAT NEVER QUIT!
AND ON THE SIXTEENTH OF OCTOBER...
HERE'S THE WORD, MEN! WE'VE NOT ONLY CAUGHT UP--WE'RE FINISHED EIGHT DAYS AHEAD OF SCHEDULE, THANKS TO YOU!
DON'T FORGET OUR TD-24'S, BOSS!
YEAH, MAN! YOU CAN'T BEAT FOUR "BIG RED" ACES!
YOUR CREW SURE DESERVES A HEAP OF CREDIT, RALPH! YOU HAVE KEPT DOWNTIME TO A MINIMUM ON THIS JOB.
AND THOSE BIG RED BABIES REALLY MOVE THE DIRT!
ENGINEEKS DOWN AT AREA HEADQUARTERS NICKNAMED YOU "LUCKY," PAUL!
IT TAKES MORE THAN LUCK, INSPECTOR! WHEN I GET A MAN-SIZED JOB, I GET MAN-SIZED CRAWLERS!

Meet the man they call "LUCKY"

Here's Paul Crawley, 32-year-old contractor from Edwardsville, Illinois and Clayton, Missouri. He currently (October, 1953) is working on five major levee contracts with the U. S. Army Corps of Engineers, totalling approximately 2,900,000 yards of dirt and $1,300,000.

Paul says, "Yes, I know they call me 'Lucky', but you need more than luck to make up nine weeks lost by rain and floods! We made up that time in a little more than three months. We did it with a team of top operators and mechanics who used the right equipment for the job we had to get done.

"My four TD-24 tractors showed their true worth when they kept right on working in the rain, climbing slippery levee slopes with heaping scraper loads . . . a job that caused our other tractors so much trouble we had to use them elsewhere. In one clocked 13-day period, we moved 197,700 cubic yards of dirt. TD-24 performance was a tremendous factor in helping us set this record."

By using the best in earthmoving equipment, by hedge-hopping in his two planes and by using a powerful FM radio with two-way phones in all his superintendents trucks, Paul not only kept this project rolling —he made the dirt fly on four other levee jobs at the same time!

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POWER TO MOVE THE EARTH

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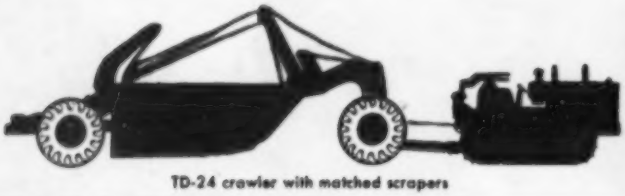

TD-24 crawler with matched scrapers

TD-18A crawler with matched scrapers

TD-24 crawler with bullgrader

TD-14A crawler with cable bullgrader

TD-9 crawler with hydraulic bulldozer

T-9 crawler with hydraulic bullgrader

TD-6 crawler with hydraulic bulldozer

T-6 crawler with hydraulic bullgrader

Model 2T-75 two-wheel, rubber-tired tractor with 18 heaped-yard capacity scraper

Model 2T-75 two-wheel, rubber-tired tractor with 20 heaped-yard capacity bottom dump wagon

Model 2T-55 two-wheel, rubber-tired tractor with 13 heaped-yard capacity scraper

The photos below illustrate typical concrete and asphalt removal practice now being employed by hundreds of Utilities, Municipalities, Contractors and Maintenance Crews in Streets, Floors and Sidewalks. The benefits include lower maintenance costs, lower installation, repair and replacement costs.

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SAVES-

...UP TO 50% on REMOVAL TIME

... UP TO 50% on REPLACEMENT COSTS

MODEL C-130—One of 5 Models—Gas or Electric Powered.

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...the First and Only saw in the world that will cut every masonry material regardless of size and hardness. Clipper outperforms them all for ONLY Clipper is "CONVERTIBLE" and has the Exclusive-Patented Features for **flexibility.** A Clipper model to fit any job—any budget. Sold on FREE TRIAL... Priced from $265.

CUT COSTS by Sawing Contraction Joints—Trench and Patch Openings in Concrete & Asphalt

Save up to 50% in labor and material. Saw repair patches—water, gas, sewer and air line trenches in floors, streets, walks, highways. Save too, by sawing contraction joints in floors and highways...eliminate costly hand forming and spalling.

"4 OUT OF 5" BUY CLIPPER CONCRETE SAWS. Three-Point Suspension holds the blade straight and true in the cut—eliminates binding—twisting—drifting—sidewear and friction. The patented water application assures adequate coolant at all times—increased blade life and speed. Perfect balance and Dashboard Controls for operating ease and maneuverability.

Experience Proves a Concrete Saw Must Have These Clipper Features for MAXIMUM ECONOMY

3-POINT SUSPENSION | WATER SPRAY SYSTEM | INSTANTLY MANEUVERABLE

FREE TRIAL ON YOUR JOB!

This unqualified Clipper guarantee of satisfaction is backed by Nearly 20 Years of world-wide experience, the ability to select the finest materials and the "know-how" to put them together. ORDER TODAY...on FREE TRIAL. Discover for yourself how Clipper will increase your profits!

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NEWS OF ENGINEERS

George W. Alexander, who has been with the Dravo Corp., Pittsburgh, since 1940, has been promoted from assistant superintendent of marine ways in the Engineering Works Division to assistant to the operations manager of the division.

George L. Davenport, Jr., of Los Angeles, was recently promoted from hydraulic engineer for the Atchison, Topeka & Santa Fe Railway to assistant to the chief engineer of the Santa Fe Coast Lines. Mr. Davenport joined the company as a draftsman in 1907 and, except for a three-year period with the City of Los Angeles Public Utilities Department, has been with the railway system continuously. A high point of his service with the railroad was supervising the construction of a water supply system for the south rim of the Grand Canyon, which involved pumping water through a 6-mile pipe from a spring 3,150 ft below the rim.

G. L. Davenport, Jr.

Edward H. Anson, until recently vice-president of Gibbs & Hill, Inc., New York, N. Y., has been elected senior vice-president. **Barclay G. Johnson,** engineering manager and secretary of the company, has been made a vice-president.

William J. Attridge has been transferred from his post as engineer at the Bureau of Reclamation's Medford (Oreg.) office to that of field engineer on the Minidoka project in Idaho.

Alvin P. Beiser, design engineer with the Kaiser Aluminum & Chemical Corp., at Permanente, Calif., is now with Rothchild, Raffin & Weirick as a field engineer on the construction and reconstruction project of the state hospital at Stockton.

Alfred C. Clarke, since 1941 chief engineer of the Baltimore and Ohio Railroad at Baltimore, Md., retired on January 1, after 38 years of continuous service. Appointed to succeed Mr. Clarke was **Karl J. Wagoner,** assistant chief engineer since 1946.

Robert M. Collie was recently admitted to partnership in the Houston, Tex., consulting firm of Freese, Nichols and Turner. Previously Mr. Collie was a designing engineer for the company.

G. L. Williams recently resigned from the planning department of the Sao Paulo Tramway, Light and Power Co., Ltd., Sao Paulo, Brazil, and is now a consulting engineer with the Harza Engineering Co., Chicago, Ill.

Howard F. Eckerlin, consulting engineer of Syracuse, N.Y., has formed a partnership with a former associate, **Lawrence E. Klepper.** The new firm, to be known as Eckerlin and Klepper, will continue the practice at the same address as Mr. Eckerlin's earlier organization—2507 James Street, Syracuse, N.Y.

Mark Falk, partner in the San Francisco firm, Falk & Booth, is currently serving as president of the Consulting Engineers Association of California. **Pecos H. Calahan,** of Burbank, is executive secretary.

John S. Cotton, consulting engineer of San Anselmo, Calif., has left on his annual trip to the Near East where he will be engaged for several months on flood control, irrigation, and power problems.

Harrison N. Culver has been transferred to Oak Ridge by the TVA Division of Power Operations to study the application of nuclear energy to the generation of electric power. Mr. Culver has been serving as structural engineer in the TVA Division of Design at Knoxville.

Alexander Foster, Jr., vice-president of the Warner Co., Philadelphia, Pa., is now engaged in supervision of all retail yards in Philadelphia, Morrisville and Wilmington and in marine transportation.

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Gustave Magnel, M. ASCE (center), who served as consultant in the early stages of construction of Philadelphia's Walnut Lane Bridge, first prestressed concrete bridge in the United States, visits the site of the completed structure during his recent visit to the United States and Canada. Shown with him are Charles C. Zollman, A.M. ASCE (left), former student of Dr. Magnel at the University of Ghent and now chief engineer, Vacuum Concrete, Inc., Philadelphia, and Samuel Baxter, M. ASCE, chief engineer, Bureau of Engineering, Surveys and Zoning, both of whom participated in construction of the bridge. Dr. Magnel is in the United States lecturing on prestressed concrete.

Grayson Gill, architect and engineer of Dallas, Tex., recently formed a partnership with **C. L. Willis,** former district airport engineer with the Civil Aeronautics Administration at Fort Worth, which will specialize in airport planning. Mr. Gill is currently serving as president of the Dallas chapter of the American Institute of Architects.

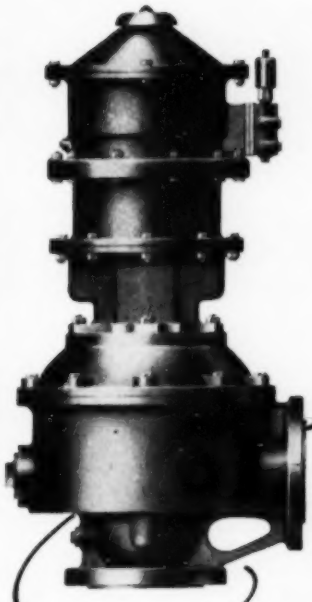
Drahn Jones, city engineer for Waco, Tex., assumed new duties as director of public works for the City of Corpus Christi, in January.

Roy A. Klein has retired from the Bureau of Public Roads after 20 years of service as division design engineer in the Denver and Fort Worth Division offices. He will make his home in Oregon where he was formerly state highway engineer (1923–1932). Mr. Klein is a past-president of the Colorado Section and has been active in the Fort Worth Branch of the Texas Section.

Paul M. Zander is now practicing civil and sanitary engineering as Paul Zander & Co., at 509 East Markham, Little Rock, Ark. Previously he was a member of the recently dissolved firm of consulting engineers, Blaylock & Zander, Little Rock.

William M. Jaekle has been appointed assistant chief engineer for the Southern Pacific Co., at San Francisco.

(Continued on page 110)



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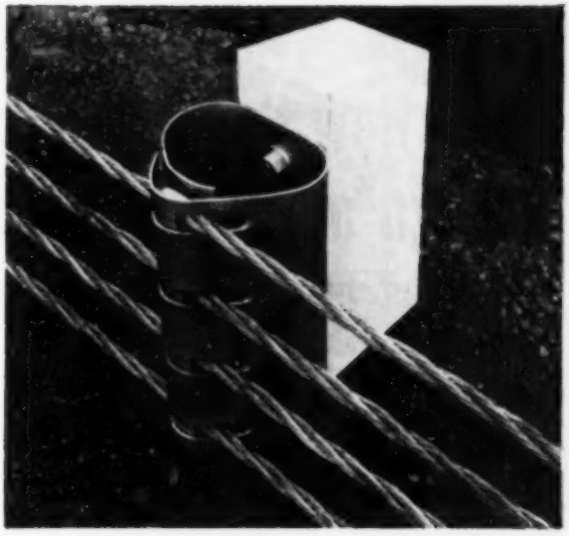

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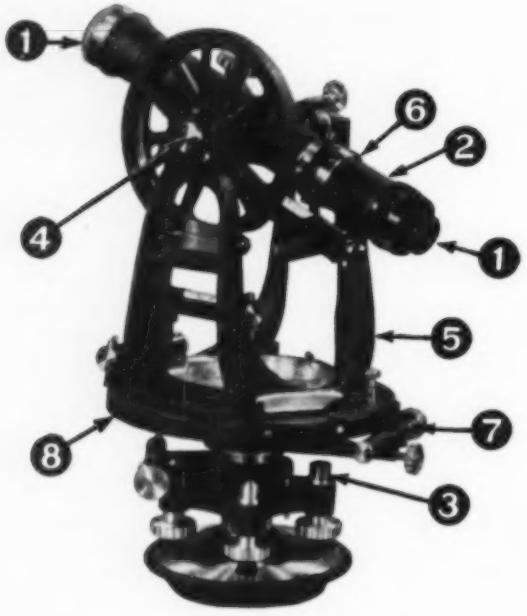

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News of Engineers

(*Continued from page 107*)

F. G. Merckel has been elected president of the newly formed firm of Wallace & Tiernan, Inc. (created by the merger of Wallace & Tiernan Co., Inc., and Novadel-Agene Corp.). Headquarters of the firm will continue to be in Newark, N.J. For almost 35 years Mr. Merckel has held various executive and sales positions with Wallace & Tiernan Co., Inc., including for the past two years, the presidency of a subsidiary, W. C. Hardesty Co., Inc. Named vice-president in charge of product engineering and development was **G. D. Peet,** who has served as chief engineer and officer for Wallace & Tiernan subsidiaries.

F. G. Merckel

Jack E. McKee, associate professor of sanitary engineering at the California Institute of Technology, was recently appointed a member of the California State Department of Health's Advisory Committee on Sanitary Engineering.

Samuel F. Newkirk, Jr., engineer and superintendent of the Elizabeth (N.J.) Water Department, has been elected an honorary member of the American Water Works Association. Mr. Newkirk is a former director, vice-president, and president of the AWWA, and holder of its Diven Medal and Fuller Award.

S. F. Owen, assistant engineer in the Public Works Department, Alor Star, Kedah, Federation of Malaya, has been promoted to senior executive engineer, with headquarters at Seremban, Negri Sembilan. Mr. Owen recently returned from an eight-month leave in the United Kingdom.

T. W. Roby retired on February 1 as valuation engineer with the Seaboard Air Line Railroad Co., with headquarters at Portsmouth, Va., after 40 years of service.

Neal B. Garver and **Mark Garver** announce the opening of a consulting engineering partnership at 325-26 Exchange Building, Little Rock, Ark. Their services will include consultation, design, and supervision of foundations, underpinning, cofferdams, airports, bridges, highways, and industrial buildings.

William G. Seyfang, managing engineer and director of plants for the Buffalo (N.Y.) Board of Education, has been appointed by the mayor of Buffalo to serve as commissioner of public works.

Harold F. Sommerschield was recently appointed district manager of the new regional office of the Preload Construction Corp., with headquarters at 111 West Washington St., Chicago, Ill. Previously Mr. Sommerschield was assistant to the general manager of the Capitol Steel Division of the Hausman Steel Co., at Lansing, Mich.

Stewart I. Sherman, senior engineer in the Bureau of Engineering of the New York City Board of Estimate, was installed as second vice-president of the Municipal Engineers of the City of New York, at the society's annual meeting on January 22. Other ASCE members elected to office in the organization are **Leo N. Komiakoff,** civil engineer in the department of City Planning, secretary; and **Thomas K. A. Hendrick,** senior engineer, Board of Water Supply, treasurer.

Albert C. Spann, district engineer for the U. S. Bureau of Public Roads, at Cheyenne, Wyo., was presented a merit award at the recent convention of the American Association of Highway Officials.

Charles L. Strain, rear admiral, Civil Engineer Corps, USN, has relieved **Rear Admiral Algert Daniel Alexis,** CEC, USN, as director of the Atlantic Division of the Bureau of Yards and Docks, New York, N.Y. Admiral Alexis is retiring after more than 32 years of Naval service. Admiral Strain was previously assistant chief of plans and research, in the Bureau of Yards and Docks, Washington, D.C.

Frank C. Tolles, who retired on January 1, as an active partner in the firm of Havens and Emerson, consulting engineers of Cleveland and New York, is being retained as a consultant. Mr. Tolles is a former Society Director. **Frank S. Palocsay** and **Edward S. Ordway** have been admitted to the firm as partners and **Alvin M. Mock** and **Glen H. Abplanalp** have been advanced to the position of principal engineer.

Maxwell R. Warden, until recently vice-president and assistant general manager of the Remington Arms Co., Inc., Bridgeport, Conn., has been elected president and general manager. For many years in the E. I. du Pont engineering department, Mr. Warden joined the Remington company, a du Pont subsidiary, in 1941.

R. S. Green

J. R. Shank

Robert S. Green, chairman of the department of welding engineering at Ohio State University, has been named executive director of the university's Engineering Experiment Station, effective April 1. A member of the staff since 1947, Professor Green will remain as head of the department of welding engineering and part-time professor. He succeeds **Prof. Jacob R. Shank,** assistant director since 1938, who will devote full time to his professorship in the department of civil engineering.

(*Continued on page 112*)

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News of Engineers

(*Continued from page 111*)

Kenneth H. Larkin and Associates are now occupying an office building at 19 E. Gregory Boulevard Kansas City, Mo., which the firm recently designed and constructed. During the past five years, the organization has served as design engineer on a number of sewer and sewage disposal plants and water supply and water-works projects.

John H. Bringhurst, Jr., associated with the J. E. Sirrine Co. of Greenville, S.C., since 1937, recently was made a partner in the firm.

Charles S. Hazen, U. S. Bureau of Reclamation area planning engineer, serving for the past two years as water management officer at Grand Coulee Dam, has been named area engineer for the Bureau's Spokane Project Development Area.

C. M. Howard, engineer manager for the Concrete Products Association of Washington, with headquarters in Seattle, was recently appointed to a five-year term on the Washington State Board of Registration for Professional Engineers and Land Surveyors.

Coverdale & Colpitts, consulting engineers of New York City, are celebrating the fiftieth anniversary of the founding of the firm. Partners in the organization include; **Geo. W. Burpee, Geo. H. Burgess, John E. Slater, A. P. Farnsworth, Miles C. Kennedy, Geo. V. T. Burgess, W. A. Gordon, S. P. Brown,** and **R. F. Passano.**

Harold H. Jaquet, associated with the Jefferson Lake Sulphur Co., Brazoria, Tex., for the past 20 years, is now serving as general manager and director of sulphur operations for the Pan American Sulphur Co., whose headquarters are in Dallas.

Harold D. Jolley, senior vice-president of Ceco Steel Products Corp., Chicago, Ill., has been appointed to the newly created position of senior vice-president and manager of sales. **Howard J. Richter** has been promoted from assistant manager of the organization's steel joint and roof deck department to manager.

Burnside R. Value, partner in Seelye, Stevenson, Value & Knecht, New York consultants, has been reelected president of the New York Association of Consulting Engineers for a second term.

G. T. McCoy, highway engineer with the California State Highway Division at Sacramento, has been elected first vice-president of the American Association of State Highway Officials. Outgoing president **R. H. Baldock,** of Salem, Oreg., automatically serves on the executive committee for the year.

Francis S. Friel, president of Albright & Friel, Inc., Philadelphia, Pa., has been elected vice-president of the American Institute of Consulting Engineers for 1954. Mr. Friel has just completed a term as Director of the Society.

Robert C. Johnson, president of the Siesel Construction Co., has been appointed by the Governor of the State of Wisconsin as a member of the newly-created five-man Milwaukee County Expressway Commission charged with the responsibility of planning and constructing a metropolitan expressway system for Milwaukee County.

D. R. Donlen recently retired as manager of the asphalt sales department of the Texas Company, New York, N.Y., following 30 years with the firm.

Solution to problem on page 60

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HYDRAULIC ENGINEER; M. ASCE; 42; married; M.S. and C.E.; professional engineer, Florida; 20 years' progressive professional experience concentrated various phases hydraulic engineering, design, hydrology, sediment transportation, and preparation of technical reports thereon; technical experience accompanied by administrative and personnel management responsibilities. Qualified to direct planning, design and operation of hydraulic projects. C-930.

CIVIL ENGINEER; A. M. ASCE; 38; married; B.S. and M.S.; 15 years' responsible and varied experience in foundation and earthworks design and construction and concrete technology. Design, plans, specifications, estimates for structural foundations, earth and rock-fill dams, levees, and highway and airfield pavements. Foundation exploration and materials testing. C-931.

HYDRAULIC ENGINEER; M. ASCE; 40; married; C.E., M.S. in C.E.; registered civil engineer, California. Outstanding experience in hydraulics and construction engineering; 8 years in key supervisory positions; top references. Design, planning, estimates, reports for water resources developments; hydraulics laboratory; military construction, Korea. Desires responsible supervisory position, considering teaching. Location preferred, West Coast. C-932-539-A-2-San Francisco.

PROJECT SUPERINTENDENT; A. M. ASCE; 41; married; registered; 20 years' balanced supervision of construction and engineering; diversified and heavy construction; experienced power plant, industrial chemical, petroleum production and refinery facilities, atomic energy plants, mining and ore dressing. Desires position with responsibility to management for complete assignments, domestic or foreign. C-933-495-A-7-San Francisco.

CONSTRUCTION SUPERINTENDENT; J. M. ASCE; 30; married; graduate civil engineer. Aggressive, successful record as job organizer on two foreign projects; experienced on deep water pier construction, public buildings, roads. Foreign work acceptable if dependent can accompany. C-934-541-A-3-San Francisco.

CONSTRUCTION ENGINEER; J. M. ASCE; 24; single; 2 years' experience on a power plant in Arabia. Desires work as an assistant to project superintendent in a medium sized construction company on the west coast, preferably northwest. Available in September. C-935.

CIVIL ENGINEER; M. ASCE; 51; married; Dr. Sc. in C.E.; experience as designer and construction manager of important engineering works, bridges, dams and industrial buildings; knows Brazilian and Peruvian conditions. Speaks Spanish and Portuguese fluently. Desires senior position. Location preferred, Brazil or Peru. Presently located, Norway. C-936.

CIVIL ENGINEER; J. M. ASCE; 32; single; B.S.C.E.; Nevada license; 1 year office engineering, estimates and reports; 1 year design, canals and canal structures; 1 year charge of field control earth and concrete laboratory, large dam; 1 year charge surveys and inspections, canal; 1 year supervisory engineer. Interested in foreign heavy construction. C-937.

CIVIL ENGINEER; M. ASCE; B.S.C.E.; 44; married; registered professional engineer. Experienced in large city public works management, construction, operations; activities at policy making level, including research techniques for improving. Completed tour as colonel, Corps of Engineers command assignment during Korean emergency. Desires position opportunity with consulting or contracting organization. Location preferred, Maryland. C-938.

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CHIEF DRAFTSMAN-STRUCTURAL ENGINEER fully qualified to take complete charge of drafting department of about 30 men for a structural steel fabricating plant. Must have gained experience with a fabricating concern. Location, North Central States. Y-9469.

CIVIL ENGINEER with sanitary engineering experience covering water works, pipelines or municipal engineering for water waste surveys and distribution studies of municipal water systems. Salary open. Locations, United States and Canada. Y-9478.

SALES ENGINEER for consulting engineering and construction company, to sell company services. Should have some background in beneficiation of ores and general mining, milling and smelting processes. Salary, $9,000–$10,000 a year. Location, New York metropolitan area. Y-9487.

SANITARY ENGINEER, licensed or eligible for examination for license to practice professional engineering in New York State. Degree in sanitary or public health engineering and 4 years' public health engineering experience; or, degree in civil or chemical engineering and 6 years' public health engineering experience; or, any combination of education, experience and training which is determined to be the equivalent of either of the above. Location, New York, N.Y. Y-9497.

ENGINEER with experience in design of railroad bridges. Must be able to make field inspections, analyze structures, make capacity ratings and prepare plans. Salary open. Location, northern New England. Y-9505.

HEAD OF CIVIL ENGINEERING DEPARTMENT, under 55, with M.S. or Ph.D. degree and 10 years' teaching experience, to take charge of department, teach structures and strength of materials. Immediate appointment. Apartment or heated house on campus at reasonable rent. Salary, $6,000–$6,500 a year. Location, northern New England. Y-9527.

ARCHITECTURAL ENGINEER, 40–45, 15 years' minimum experience in building construction as engineering designer and building architect. Should have B.S. degree in architecture, architectural engineering or civil engineering. Should be registered architect with knowledge of building engineering, design, construction and alteration. Drafting plans and writing up specifications. Coordination and direction of construction work. Salary open. Location, New Jersey. Y-9562.

GENERAL MANAGER for structural steel fabricating plant; graduate civil engineer; 40–55. Must have had considerable experience in structural steel fabrication and some management experience. Will be directly in charge of plant, responsible only to home office. Salary open. Location, Pennsylvania. Y-9615.

STRUCTURAL ENGINEER, about 40, professional C.E. license in New York State; must have experience in structural steel fabrication and erection. Salary, $9,000–$10,000 a year. Location, New York State. Y-9644.

ENGINEERS. (*a*) Construction Superintendents, with experience in industrial and office buildings or boiler house. Must be cost conscious and a producer. Will take complete charge of either of the above and will be responsible for all phases of work. Salary, $8,000–$10,000 a year. (*b*) Project Manager, with technical education, and experience on office buildings, boiler plant, industrial buildings, railroad spur, sewage disposal system, water supply, roads, drains, parking areas, etc. Will report directly to an officer of the contracting firm, and take charge of the complete project. Will represent the contractor in his absence. Will supervise labor relations. Salary, $10,000–$12,000 a year. (*c*) Estimator, engineering background and 6 years' general estimating experience on above projects. Will prepare estimates on all phases of the general work. Assist accountant and other key men in cost control; receive, handle, distribute and file all drawings, prepare progress charts, delivery schedules, approve shop drawings, etc. Salary, $6,000–$8,000 a year. (*d*) General Superintendent, with minimum of 10 years' qualified experience on above projects. Will be responsible for actual construction progress. Take charge of all assistant superintendents and field engineers. Delegate work and have knowledge of the entire project at all times. Salary, $10,000–$12,000 a year. Location central New York State. Y-9648.

RECRUITMENT ENGINEER with excellent contact ability and mature judgment, as well as a professional engineering education or the equivalent, to handle engineering recruitment activities. Will be required to coordinate engineering recruitment programs in a major geographical area with New York City as the focal point. Over 75 percent of time will be spent in travel in order to make necessary contacts, conduct interviews and perform related recruiting functions. Salary to start, $7,500–$9,000 a year plus per diem allowance and travel expense. Y-9669.

ENGINEER, civil graduate, 28–45, interested and experienced in laboratory and field research and development concerned with concrete pavements. Salary open. Location, Chicago area. C-1499.

RECENT BOOKS

Disrupted Strata

A book by M. H. Haddock for the engineer connected with mining or water supply. Following an introduction dealing with the ways in which faulting may arise and a survey of major disruptions of the earth's surface, the succeeding chapters offer a detailed analysis of the many types of faults which occur, and present methods for determining the positions of disrupted strata and for measuring them. Perspective sketches illustrate the text and a bibliography is appended. (Technical Press Ltd., London: distributed in U.S. by Anglobooks, 475 Fifth Ave., New York 17, N.Y., third edition, 1953. 104 pp., $5.)

Earth Pressure Calculation

This work by Jørgen Brinch Hansen contains, in addition to a short description of the known methods, the principles of a new general calculation method, as well as numerous detailed applications to practical earth pressure and stability problems for retaining walls, cofferdams, sheet walls, etc. A new theory of rupture is used, based on a connection between the extreme-method and the equilibrium-method. There is a considerable bibliography. (Danish Technical Press, Copenhagen, 1953. 271 pp., $4.30.)

Fifty Years of Paint Testing

Special Technical Publication No. 147 consists of a series of reports presented in 1952 which summarize the results of ASTM activities in the field. Major group headings include the following: drying oils, volatile hydrocarbon solvents, accelerated tests, chemical analysis of paint materials, varnish and shellac, pigment specifications, physical and optical properties of materials, protection of iron and steel. (American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa., 1953. 47 pp., $1.25.)

Die Hebezeuge
Volume III: Sonderausführungen

Volume III of this series—written by Hellmut Ernst—on hoisting equipment provides brief theory and thorough description of the characteristics of various specialized types: traveling workshop cranes; mill, dockyard, and floating cranes; shipboard hoisting equipment; mobile and railroad cranes; cableways; building and bridge cranes; composite materials-handling plants; weighing devices for hoisting equipment. Well-illustrated with many detailed sketches. (Friedr. Vieweg und Sohn, Braunschweig, Germany, 1953. 287 pp., DM 45.80.)

Introduction to Dynamics

The scope of this book is defined as the study of motion in two dimensions—particle, rigid body, system—without Lagrange's equations. The material is arranged, from a discussion of scalar and vector quantities up through the motion and momentum of systems, to provide a logical and natural development of the subject. A number of special aspects are covered by the author, L. A. Pars, as well as the basic general theories. (Cambridge University Press, 32 East 57th St., New York 22, N.Y., 1953. 501 pp., $6.)

Manual of Traffic Engineering Studies

A comprehensive reference work on the methods, forms, and analysis of traffic studies, designed to be of use to city planners, transportation officials, police, and students, as well as to traffic engineers. In addition to the 28 case studies there is also information on the origin, financing, and planning of surveys, on statistical treatment of data, report preparation, and other aspects. Revised to incorporate recent significant developments. (Accident Prevention Department of the Association of Casualty and Surety Companies, 60 John St., New York, N.Y., second edition, 1953. 278 pp., $3.75.)

Past Examinations for Professional Engineer—New York State

This compilation, by John D. Constance, of problems from past Professional Engineers License Examinations in New York State now covers the period from January 1943 through June 1953. It includes the complete set of Parts I, II, and III in all cases. (John D. Constance, 625 Hudson Terrace, Cliffside Park, N.J., 1953 edition. $1.50.)

Route Location and Surveying

Previously entitled "Highway Surveying and Planning," this classroom text, field manual, and reference work in general engineering practice, has now been broadened to include transportation systems such as railways, canals, pipe lines, airways and airports. Although the emphasis is on the mathematical background of basic principles, adequate tables and procedures are provided to expedite the work of the field party. Thomas F. Hickerson is the author. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y., third edition, 1953. 543 pp., $6.)

National Research Council Highway Research Board, Proceedings of the Thirty-Second Annual Meeting, 1953

The 44 papers included in this volume are broadly classified under the following headings: economics, finance, and administration; design; materials and construction; maintenance; traffic and operations; soils. They cover a variety of topics, and represent recent, authoritative research in the various fields dealt with. (National Research Council, Washington, D.C., 1953. 616 pp., $8.50)

Jahbruch Der Wissenschaftlichen Gesellschaft Fur Luftfahrt, 1952

A wide range of topics is covered by the papers presented at this German conference: wind tunnel developments; boundary suction as an aerodynamic aid; production of smooth wing surfaces; weight-saving construction methods for airplanes; aircraft propulsion methods, with separate papers on piston engines, turbo-engines, and ram-jets; air navigation systems. Hermann Blenk has edited the material. (Friedr. Vieweg & Sohn, Braunschweig, 1953. 148 pp., DM 24.)

Reinforced Brick Masonry and Lateral Force Design

A concise 260-page book giving data on performance of masonry structures and design and construction procedures based on these data. Of special interest are procedures which tests and experience indicate, will develop in masonry structures resistance to lateral forces resulting from blast, wind and earthquake. Building Code requirements for lateral forces, design examples, and an ample bibliography have been included by the authors, Harry C. Plummer and John A. Blume, both M. ASCE. (Structural Clay Products Institute, 1520 18th Street N.W., Washington, D.C. $4.95.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.

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New Publications

Public Works. The currently available Proceedings of the 1953 Public Works Congress, held in New Orleans in October, comprises papers on Civil Defense; Composting as a Method of Garbage Disposal; Intergovernmental Relations in Public Works; Design and Operation of Municipal Incinerators; Street Uses; and Performance Budgeting in Public Works. Copies may be obtained from the American Public Works Association, 1313 East 60th Street, Chicago 37, Ill. The price is $5, with a 10 percent discount if payment accompanies the order.

Pipe Fittings. Issuance of a revision of one of the most widely used American Standards, *Steel Pipe Flanges and Flanged Fittings, B16.5*, is announced by the American Standards Association. Incorporating data on new materials in the field, the revision provides for fifteen different types of steel, and covers nominal pressures of 150, 300, 400, 600, 900, 1,500, and 2,500 psi. The cost is $5, and orders should be sent to the American Standards Association, Inc., 70 East 45th Street, New York 17, N.Y.

Structural Design. As the second in a series of publications based on research for the Robberson Steel Co., of Oklahoma City, Oklahoma A & M College has made available a study of the stress analysis of continuous highway bridges by a new distribution factor. The 100-page report is identified as Engineering Experiment Station Publication No. 89 and entitled *Displacements of Supports in Frames with Constant Moment of Inertia and Sideway Prevented*. Copies, priced at $1.25, may be obtained from the Engineering Experiment Station, Oklahoma A & M College, Stillwater, Okla.

Fire-Resistant Building. For engineers, architects, and others interested in fire-resistant building, the National Board of Fire Underwriters has made available a 48-page pamphlet of fire-resistance ratings. A revision of Appendix A of the Board's National Building Code, the publication contains a number of tables on such ratings of beam, girder, and truss protection; ceiling construction; column protection; floor and ceiling construction; roof construction; and walls and partitions. Single copies of the pamphlet are available without charge from the National Board of Fire Underwriters, 85 John Street, New York 38, N.Y. Persons living in the Middle West should write to 222 West Adams Street, Chicago 6, Ill., and west of the Rockies to 465 California Street, San Francisco 4, Calif.

Highway Research. Different phases of highway research are dealt with in three recent publications of the Highway Research Board: Bulletin 70, entitled "Air-Entrained Concrete: Properties of Air Voids and Service Record of Pavements"; Bulletin 72, on "Directional Channelization and Determination of Pavement Widths"; and Special Report 10, which discusses "Investigation of Wind Forces on Highway Bridges." Bulletin 70 sells for 45 cents and Bulletin 72 for 75 cents. No price is available for Special Report 10. Requests should be sent to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Professional Personnel. For maximum utilization of professional and technical personnel, the Institute of Public Administration, University of Michigan, and the Civil Service Assembly of the United States and Canada have made available the results of a cooperative project in the field as its Personnel Report Series No. 534. The report—entitled *Guide to Personnel Activities of Professional and Technical Associations* and written by Dorothy W. Otten—may be obtained from Civil Service Assembly, 1313 East 60th Street, Chicago 37, Ill. The list price is $2 a copy (with a 10 percent discount available for cash payment with the order) and $1 a copy for lots of ten or more copies.

Industrial Research. Availability of a report entitled *Scientific Research and Development in American Industry*, prepared by the U.S. Labor Department's Bureau of Labor Statistics, is announced by the Department. Based on the findings of a survey of nearly 2,000 concerns with large research programs, conducted during 1952 by the Research and Development Board of the Department of Defense, the report is identified as Bulletin 1148 of the Bureau of Labor Statistics. It may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., for 50 cents a copy.

Public Health. Sanitary engineering aspects of swimming pools and bathing beaches are studied in the recently issued Proceedings of the Sixth Public Health Engineering Conference, which was held at the University of Florida in March 1953. Free copies of the publication, identified as Bulletin Series No. 62, may be obtained from the Director, Florida Engineering and Industrial Experiment Station, Gainesville, Fla.

Hydraulic Research. The status of hydraulic research is reviewed in three currently available volumes. For the United States, the National Bureau of Standards has issued a 200-page compilation, entitled *Hydraulic Research in the United States*, which comprises reports from the various hydraulic and hydrologic laboratories here and in Canada. This reference is for sale by the Government Printing Office, Washington 25, D.C., at $1.25. Another bulletin, *Hydraulic Research*, compiled and published by the International Association for Hydraulic Research, gives similar information for foreign countries. It is edited by Prof. J. Th. Thijsse, director of the Hydraulic Laboratory at the Technical University of Delft, Netherlands, from whom it may be obtained at $6 a copy. Also available is a *Directory of Hydromechanics Research Projects in the United States Related to Naval Architecture and Marine Engineers*, prepared by the Hydrodynamics Committee of the Society of Naval Architects and Marine Engineers. Inquiries should be addressed to Capt. W. N. Landers, Secretary of SNAME, 29 West 39th Street, New York 18, N.Y.

Mississippi Maps. Availability of the 1953 edition of "Flood Control and Navigation Maps, Mississippi River," is announced by the Mississippi River Commission. Prepared from data charted as recently as October 1953, the new folio covers the 966-mile stretch of river from the mouth of the Ohio at Cairo, Ill., to the Gulf of Mexico. The map scale is 1 to 62,500, or about 1 in. to one mile. Copies, priced at $2 each, may be obtained from the District Engineer offices at Memphis or New Orleans or from the President, Mississippi River Commission, P.O. Box 80, Vicksburg, Miss.

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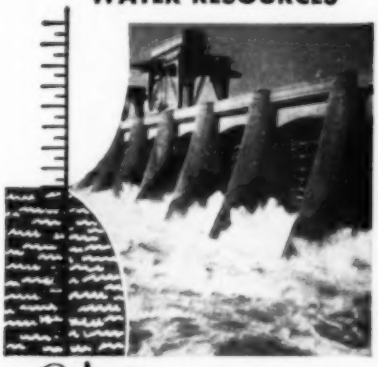

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Non-ASCE Meetings

American Chemical Society. The American Chemical Society will hold its 125th national meeting in Kansas City, Mo., March 24–April 1.

American Power Conference. The Illinois Institute of Technology, in cooperation with 14 other universities and nine professional engineering societies, is sponsoring the 16th annual American Power Conference to be held at the Sherman Hotel, Chicago, Ill., March 24–26.

American Society of Mechanical Engineers. The ASME will hold its 1954 International Meeting in Mexico City, March 10–12, with headquarters at the Hotel del Prado. Information about the ten-day guided tour (optional) which will follow the meeting, may be obtained from ASME Deputy Secretary Ernest Hartford.

American Railway Engineering Association. The national convention of the American Railway Engineering Association is scheduled for the Palmer House, Chicago, Ill., March 16–18.

Chi Epsilon. The biennial Conclave at Cornell University, April 8–10, will be attended by all Supreme Councillors, and delegates from 47 chapters. To register in advance, contact Sidney Okes, Jr., President, Chi Epsilon Fraternity, Department of Civil Engineering, Cornell University, Ithaca, N.Y. New York Alumni Chapter will meet at 33 W. 39th St., April 7, 7:30 p.m., preceded by an informal supper in the New York Times Building Dining Room at 6 p.m.

International Conference on Large Electric Systems. The 15th session of the International Conference on Large Electric Systems will be held at 28 Bis, Rue Saint-Dominique, the Fondation Berthelot, Paris, France, May 12–22. For information write to the U. S. National Committee of CIGRÉ, 50 Church St., Room 1781, New York 7, N.Y., or CIGRÉ, 112 Boulevard Haussmann, Paris, France.

National Association of Corrosion Engineers. The National Association of Corrosion Engineers will hold its tenth annual conference and exhibition at the Kansas City Municipal Auditorium, Kansas City, Mo., March 15–19.

Society of Automotive Engineers. Headquarters for the National Production Meeting and Forum of the Society of Automotive Engineers will be the Drake Hotel, Chicago, Ill., March 29–31.

Society for Experimental Stress Analysis. The Netherlands Plaza Hotel, Cincinnati, Ohio, will be the headquarters for the spring meeting of the Society for Experimental Stress Analysis, April 14–15.

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Positions Announced

Merrick and North Merrick Boards of Education. The newly-created post of Superintendent of Buildings and Grounds for five schools under the supervision of the Merrick and North Merrick (New York) Boards of Education is open at a beginning salary ranging from $7,500 to $8,000. Candidates with training and experience in such fields as construction, blueprint reading, writing specifications, building maintenance, or industrial management, should submit a résumé and references, together with a request for an interview to Dr. Roland Chatterton, District Principal, 108 North Merrick Ave., Merrick, N.Y.

Wright-Patterson Air Force Base. The Equipment Laboratory of the Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, announces the following vacancies: Supervising Structural Research Engineer (GS-13) at $8,360 a year; and Structural Research Engineer (GS-11) at $5,940. An application for federal employment, Standard Form 57, may be obtained from any post office or the Commander, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. Applications should then be submitted to the Commander, Attention: WCPCU-3.

Borough of Fair Lawn, N.J. A permanent position is available in the Engineering Department of the Borough of Fair Lawn, N.J., for a civil engineer with a minimum of two years of experience and a degree from an accredited engineering college. The position, Senior Engineer-Draftsman, carries an annual salary ranging from $4,520 to $5,500. Candidates should address the Borough Engineer, 115 Plaza Road North, Fair Lawn, N.J., or call FA 6-1700, for further information.

U. S. Civil Service Commission. Open competitive unwritten examinations for engineers in various fields such as architectural, civil and general engineering, are described in Announcement No. 6-42-2 (1954) recently issued by the U. S. Civil Service Commission. The list of qualified persons resulting from the examinations, will be used to fill current and future vacancies in Headquarters of the Air Material Command, Air Development Center, Air Technical Intelligence Center, and other organizations located at Wright-Patterson Air Force Base and Gentile Air Force Depot, Dayton, Ohio. Applicants should file Standard Form 57 and Form 5001 ABC, with the Board of U. S. Civil Service Examiners, Department of the Air Force, Wright-Patterson Air Force Base, Ohio.

City of Los Angeles. Several vacancies for the position of Civil Engineering Assistant with the Civil Service Commission of Los Angeles, Calif., are available until further notice. Requirements for the position, which pays from $395 to $489 a month, are a civil engineering degree, engineer-in-training certificate or equivalent experience. An examination by interview is given daily, Monday through Friday (excluding legal holidays) at 2 p.m. in Room 5, City Hall, Los Angeles, Calif.

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Edward Wright Crowe, Guatemala, Central America.
Seymour Franklin Coffman, Minneapolis, Minn.
Roy Kimple Cramer, Tacoma, Wash.
Ben Ammos Gitchel, China Lake, Calif.
Charles Eric Handley, La Paz, Bolivia, S.A.
John Jackson Hedrick, Jr., Tampa, Fla.
James Hallowell Holcombe, Buffalo, N.Y.
Robert Vincent Killewich, Juneau, Alaska.
Joseph Harold Landre, Detroit, Mich.
Frank Hugh Lerchen, Balboa Heights, C.Z.
George Alfred Lewis, Independence, Calif.
Norbert William Maurer, Kirkwood, Mo.
Audley Allen Maxwell, Vicksburg, Miss.
Benjamin Robert McGrath, Boulder City, Nev.
Max W. Moody, Honolulu, Hawaii.
John Joseph Mozzochi, Glastonbury, Conn.
John Francis Mulgrew, San Diego, Calif.
John Charles Myatt, Honolulu, Hawaii.
James Glenn Newman, Lake Jackson, Tex.

(*Continued on page 120*)

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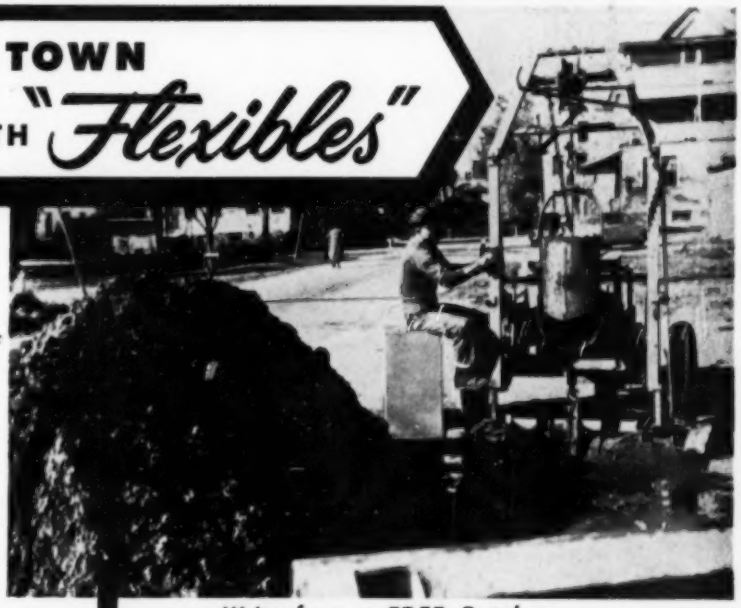

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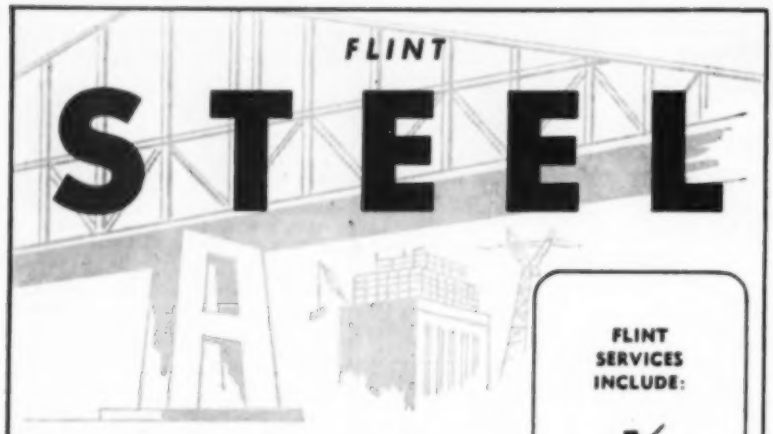

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(*Continued from page 118*)

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Emanuel Dewey Parmer, Beaumont, Tex.
Philip Harold Perkins, Government of Kuwait, Persian Gulf.
Albert Zabriskie Richards, Jr., Salt Lake City, Utah.
Leonard Fogg Sanborn, Boston, Mass.
Edward Sanel, New York, N.Y.
Albert R. J. Schneider, Chicago, Ill.
Edwin Abbott Thomas, Klamath Falls, Oreg.
Ralph Denton Witt, Warwick, Va.
Vujica Yevdjevich, Belgrade, Yugoslavia.
Joseph Earl Young, Moorhead, Minn.

Applying for Associate Member

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William Edward Barmore, Augusta, Ga.
Euro Brandao, Parana, Brazil.
Carroll Stewart Brown, Louisville, Ky.
Frank Joseph Budroe, China Lake, Calif.
John Russell Carney, Sheffield, Ala.
Edward Dominic Casaroli, China Lake, Calif.
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John Allan Crow, Stockton, Calif.
Samuel Abner Davis, China Lake, Calif.
William Grey Devitt, Toledo, Ohio.
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John Parkin Goggin, Marathon, Fla.
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Donald Rey Woods, Seattle, Wash.

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Edwin Charles Beethoven, Los Angeles, Calif.
David Perkins Billington, New York, N.Y.
William Jennings Buchanan, Jr., Oklahoma City, Okla.
Hong-Ching Chan, Wanchai, Hongkong.
Chien-Hai Chen, Wanchai, Hongkong.
Richard Sing Yip Chun, Honolulu, Hawaii.
Andrew William D'Angelo, New York, N.Y.
James Cox Egan, Jr., Philadelphia, Pa.
David Alex Fiet, Wilmington, Del.
Harry Steve Georas, New York, N.Y.
James Gerald Gulliver, Atlanta, Ga.
Anders Kristian Jensen, Senter, Mich.
Vicente Jimenez, Jr., Baguio City, Philippine Islands.
Eugene Richard Kasper, Toledo, Ohio.
Christen Mills Knudsen, Riverside, Calif.
John Leroy Lewis, Richmond, Va.
Jean Philippe Loustau, Knoxville, Tenn.
Aftab Ahmad Khan Malik, Risalpur, Pakistan.
Clifford Andrew Manchester, Waterville, Me.
Addison Dean Minott, New York, N.Y.
William Stanley Nash, Houston, Tex.
Clarence Lee Newton, Jr., La Mesa, Calif.
Panaghiotis Anastasios Petropoulos, Atlanta, Ga.
James Bowen Robertson, China Lake, Calif.
Willard Curtis Robinson, Edwards, Calif.
Albert Creighton Solnok, Tulsa, Okla.
Alexander Balthasar Stavovy, Washington, D.C.
John Newell Strommen, China Lake, Calif.
Jack Carlton Thompson, Kansas City, Mo.
Reclus Roca Vila, Falcon, Venezuela.
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[Applications for Junior membership from ASCE Student Chapters are not listed]

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EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Front End Loaders

FRONT END LOADERS in several sizes that feature torque converter, power steering and reversing planetary transmission as standard equipment are now offered. These units, which will be merchandized through Le Roi's Construction and Mining Division range in size from ½ yd to 1½ yd capacity. The patented bucket rocking action and the scooping motion of the lift arms assure full bucket load within seconds without tire spinning and other

TLF-150

undue strain on the loader. Bucket rocking action, makes for fast loading in all models, and is the result of the rocking motion of the hydraulic cylinders which are placed well back out of the dirt agitating area on the machines and afford extra reach. The TLF-150 can move to discharge points at speeds ranging up to 18 mph. Four wheel drive and low center of gravity put powerful traction on all four wheels of this unit to boost production and eliminate tire slippage. Because of this feature the TLF-150 is able to walk through sand, mud, snow, or tread with ease over treacherous rocky terrain. Easy access and maintenance of the Transo units is made possible by the compact grouping of torque converter, engine, transmission, and clutch at the rear of unit. All sizes will be powered by Le Roi heavy duty engines and will be available with reputable Diesel also. Other important economy features of the loaders are the rugged Transo planetary type reversing transmission and torque converters employed in all models. Power is transmitted fast and efficiently at very low torque. Shock loading is cushioned by a smooth operating spring loaded clutch on the outside of the transmission. Clutches can be replaced in less than an hour's time. Heavy cast iron grills on all units give extra protection to the rear end and act as counterweights thus eliminating poor road clearance. Operator vision is especially good due to the low 36 to 48 in. normal carrying position. The low carrying position is also an important safety feature. **Le Roi Company, CE 3-122, 1706 South 68th St., Milwaukee 14, Wis.**

Lift Truck

A COMPLETELY new 15,000 lb capacity lift truck has just been released according to an announcement. The lift truck, the Model RC-150, mounted on 8.25 × 20 pneumatic tires, is powered by a heavy-duty watercooled industrial engine. The RC-150 features an exclusive engineering achievement to assure unmatched job performance in adverse ground conditions. This outstanding all weather traction is said to be the result of integrated design combining features such as balanced weight, greater power and large size tires, to enable the truck, loaded or unloaded, to negotiate roughest terrain. The very latest in lift truck engineering, the truck

Model RC-150

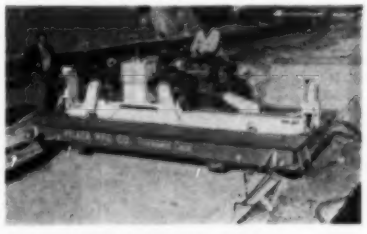
was functionally designed for appearance as well as efficiency with the assistance of the well-known industrial design firm of Henry Dreyfuss. Safety, serviceability, operator comfort and ease of operation are "built in" the truck. The RC-150 has a capacity of 15,000 lbs at 24 in. load centers. The lift truck has the shortest overall length and narrowest width in its field. Ample underclearance is said to allow safe travel over rough surfaces and inclines. Other noteworthy features are high degree of visibility, fully roller mounted uprights, extreme braking area and brute-type body construction. **Hyster Company, CE 3-122, 2902 N. E. Clackamas St., Portland 8, Ore.**

Chain Saw

AN EASY to operate full 3 hp saw, the Model 318, is lightweight yet more than rugged enough to stand up under all types of operating conditions. Equipped with a standard 18 in. blade and Oregon chipper chain it is adaptable to 16, 20, 26 and 30 in. blades. A proven chain oiler, automatic clutch, transmission with safety non-metallic gear and large air cleaner are some of the outstanding advantages. **Lancaster Pump and Manufacturing Co., Inc., CE 3-122, Lancaster, Pa.**

Joint Cutter

FIRST TESTS of a production-type contraction joint cutter for Portland cement concrete paving have just been completed on the Torrey Pines State Highway widening project near San Diego, Calif. The Di-Met machine, not yet named, has been specially developed for mechanizing contraction joint sawing and saving time on the job. Measuring 14 ft 6 in. across with an 8 ft depth, the machine spans the slab. It is equipped with ball-bearing wheels and rubber tires and is so designed that it can ride either the header boards of the new slab or ride one side on the headers, the other on a parallel existing slab. Conditions permitting, it can also roll directly on the green slab. An "H" beam serves as a track across the slab and supports a traversing carriage upon which are mounted two (or more) heavy duty spindles. Operation of the carriage is reversible, sawing being performed in either direction. The spindles operate simultaneously, each carrying a Di-Met concrete blade which is lowered into the concrete and takes a 6 ft traverse. The two cuts, being perfectly aligned, join up in the center of the slab, producing a 12 ft long contraction joint. The joints are precisely made, of uniform depth, exceptionally sharp and free from ravelling on the edges. No offset occurs at the juncture of the two cuts. Two 12 in. O.D. Di-Met segmented type diamond concrete blades are used on this particular unit to make the 2 in. depth of cut. Vari-

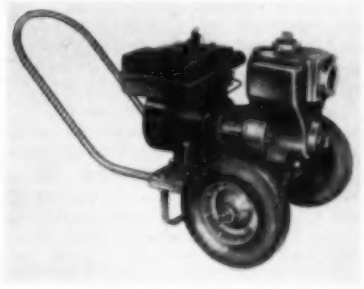


Mechanized by Di-Met

able depths of cut from 0 in. to 6 in. can be obtained using different diameter Di-Met blades for sawing contraction joints in airport runways and other similar projects. Each Di-Met blade is driven by an independent 26 hp gasoline engine with its own battery and starter. A third engine of equal horsepower and equipment drives a 3 stage hydraulic pump. Individual hydraulic motors on the rubber tired wheels provide power for road travel. By means of selector valves, hydraulic fluid is diverted as required to accomplish several functions, i.e : forward and reverse locomotion, steering, hydraulic lifting, etc. **Felker Manufacturing Co., CE 3-122, Torrance, Calif.**

Portable Pumps

A COMPLETELY NEW and vastly improved line of self-priming contractors' type centrifugal pumps are announced. Specially built to handle muddy or unclear water, the heavy-duty units are designed for water drainage or any other application where rapid movement of large volumes of water is desired. They are especially suited for use by building contractors for de-watering excavations and quarries, as well as by farm owners for draining ponds and ditches. The improved design features a balanced type of priming port which

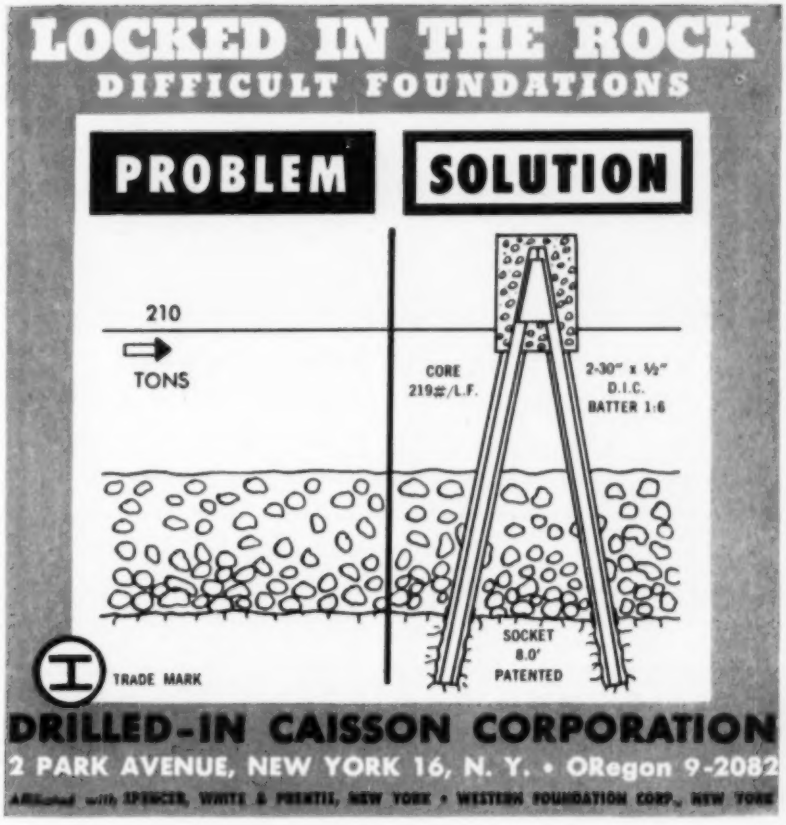


New Improved Line

prevents loss of capacity due to re-circulation of water. Semi-open impellers are non-clogging with adjustable clearance to compensate for wear; and a special renewable impeller wear plate prevents wear on the impeller case itself. Separate opening in top of case permits easy priming without need for extra fittings or disturbance of piping. These pumps are rated for continuous duty as well as for intermittent service. The pumps are now available in a wide range of horsepower ratings with choice of electric motor, gasoline engine or heavy-duty transmission head for belt drive. **Jacuzzi Bros., Inc., CE 3-123, Richmond, Calif.**

Pipe

A SPECIAL TYPE joint, long-used successfully on pressure pipe, is now available on reinforced sewer pipe manufactured by Universal Concrete Pipe Company. Universal has trade-marked the name "Armored Joint" to identify the new pipe, which combines steel joint rings and long-lasting rubber gaskets that insure against leakage or infiltration. The rings, embedded in the concrete pipe wall, are welded to the pipe's steel reinforcement. The rubber gasket is seated in a special groove in one ring so it is confined and protected. The complete joint is said to provide ample flexibility to allow for normal contraction, expansion and deflection. The long length of Armored Joint pipe speeds and simplifies installation, even under the toughest laying conditions. **Universal Concrete Pipe Co., CE 3-123, 297 S. High St., Columbus 15, Ohio**



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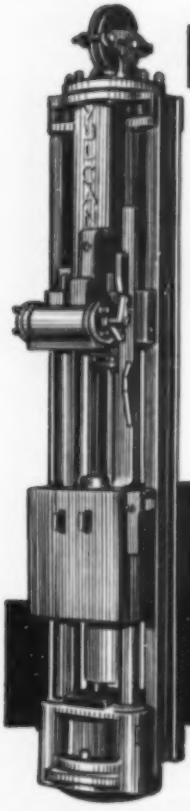

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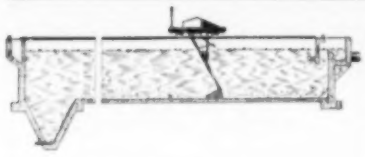
Equipment, Materials & Methods (Continued)

PeriFilter System

THE DORRCO Aldrich PeriFilter System for the pre-treatment and filtration of municipal and industrial water supplies in a single unit is announced. Color, hardness, iron, manganese, or turbidity is removed from the raw water in a mechanical pre-treatment unit and residual turbidity and bacteria in an annular rapid sand filter. For normal applications the pre-treatment mechanism in the System will be a Dorrco Hydro-Treator, although specific local purification problems may indicate the desirability of using either a Dorrco Clariflocculator of Dorr Clarifier. The annular rapid sand filter differs from conventional rectangular filters only in its peripheral placement with reference to the pre-treatment mechanism. Raw water, filter effluent, sludge, backwash water, and backwash drain flows are controlled by manual, hydraulic, or motor operated valves sheltered in a valve house adjacent to the purification unit. One valve house may serve as many as four operating units. In operation, raw water is fed directly to the pre-treatment unit, with coagulating chemicals either added by means of a head box or introduced directly into the sludge blanket. Settled solids in the pre-treatment compartment are raked by positive means to the central cone and discharged, while clarified water overflows the weir to the filter. Both compartments have an identical water level which permits a gentle transfer across a submerged weir and minimizes the disintegration of minute floc structure formed during pre-treatment. Residual turbidity and bacteria are then removed by the sand filter, and the filtered effluent flows to a discharge pipe and is pumped to storage. The major advantages of the System stem from its ability to perform both pre-treatment and filtration in a single, compact unit. The depth of water above the sand during operation eliminates air binding in the filter and centralized control may be provided by panel housed instrumentation. **The Dorr Company, CE 3-124, Barry Place, Stamford, Conn.**

Industrial Adhesive

AN ADHESIVE, claimed to provide more positive anchorage of rubber gaskets to concrete pipe even under extreme climatic conditions has been developed. The product, trade-named "BondMaster 158C", is reported to offer more uniform application characteristics, particularly in overcoming hot weather difficulties ordinarily encountered due to evaporation of solvents. In addition to the slower solvent evaporation rate, BondMaster 158C permits smoother and faster trowelling in the field than has been possible with previously existing formulations for this work. **Rubber & Asbestos Corp., Dept. P, 225 Belleville Ave., Bloomfield, N. J.**



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Particularly suitable where space is limited or where sludge delivery is desired at one end of tank. Consists of a bridge crane spanning width of the tank supporting sludge scraper and skimmer, which moves automatically back and forth.

Many of these units are now operating in sewage plants throughout the country.

This Unit has also proven highly successful as an oil-water separator in the treatment of oil refinery waste water. Bulletin 31-D-37.

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TIDE GATES

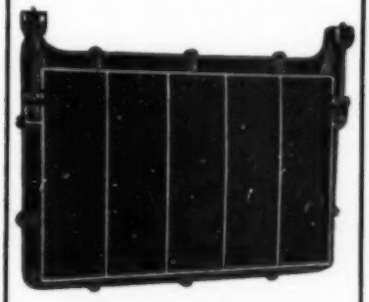

Fig. B-61. Type M-M

Type M-M (Rectangular) Tide Gates are available in 37 sizes from 8″ × 8″ to 96″ × 96″. Bulletin No. 71 describes them fully.

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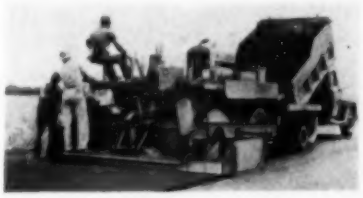
Equipment, Materials & Methods (Continued)

Paver Finisher

ANNOUNCEMENT of a rubber mounted bituminous paver finisher, Model PF-90, has been released. The machine will spread, level, and tamp hot or cold bituminous mix in one continuous operation. These pavers are also being used successfully in paving pugmill mixed lean cement mixtures. No forms are required for any of these paving jobs, according to the specifications. The rubber mounting design offers sure traction on hard surface with tack coat or on spongy sub-grades and other "tricky" surfaces. Back-tracking is faster, quieter—newly laid surfaces can be crossed sooner. Rubber tires provide traction necessary to push heavy



Model PF-90

dump trucks. An indirect benefit of rubber mounting, is the smoother action in starting and stopping—less wear and tear on pins, bushings and other parts. Another design feature which will be of lively interest to contractors is the longer wheel base and floating type screed which produce desired results with fewer passes—particularly where there have been numerous dips and bumps in the sub-grade. Other features include: the large capacity, low-cut hopper to accommodate large dump trucks; dual-drag type conveyors—individually controlled; vertical adjustment of the cross augers; dual controls; etc. **All Purpose Spreader Company, CE 3-125, Elyria, Ohio**

Hauling Yoke

A FLANGED hauling yoke on Southwest's Compaction Roller, permits changing the draft beam to match the DW-21 Caterpillar and/or other standard wheel or track-type tractors. The unit has four weight boxes which may be filled with any material to attain a single tire load as high as 53,000 lbs. Each of four weight boxes rides on its own wheel and tire. These weight boxes are hinged at the rear to oscillate independently up and down a distance of 12 in. This permits maximum compaction over the rough, uneven surface of fills without bridging or shifting the compaction load. Southwest manufactures compaction rollers in sizes from 10 to 100 tons. **Southwest Welding & Mfg. Co., CE 3-125, Alhambra, Calif.**

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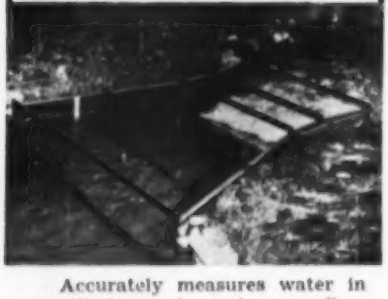

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Equipment, Materials & Methods (Continued)

Operators' Cabs

A LINE OF streamlined operators' cabs for all models of Hough Payloader tractor shovels is announced. The cabs are easily detachable and feature strong, lightweight construction with safety glass all-around for maximum visibility and safety. The glass is cushioned and sealed in locking rubber channels. Ample room is allowed for the operator and sliding side

For Hough Tractor Shovels

windows permit full ventilation when desired. These new cabs tilt up and sideward so as to make operator entrance and exit both easy and convenient. Windshield wipers front and rear can be furnished—also heater-defroster units to provide utmost operator visibility and comfort in coldest weather. Campbell 1954 Model cabs are also available for most standard makes of crawler and wheel-type tractors. **Campbell Detachable Cab Co., CE 3-126, Wauconda, Ill.**

Weather-Proofing Technique

SPRAYCRETE, a new method of applying concrete for waterproofing as well as wall construction, has been developed. Specially designed Spraycrete equipment premixes sand, water, cement and admixtures at pressures of 100# psi. Because of the patented pre-mixing technique, complete waterproofing protection for walls, tunnels or any cement interior or exterior is assured. Spraycrete differs radically from ordinary cement gun applications. Most cement guns mix material at the nozzle at same time it is being projected into place. Spraycrete high pressure pre-mixing, which eliminates shrinkage and rebound while achieving a perfect bond, is made possible by the use of patented, heavy-duty, mixing equipment. It consists of two tanks horizontally assembled with paddle agitators and one common shaft running through them. Mixing is done in the first tank and material is then blown into the second. By pre-mixing and controlling the discharge of the thoroughly mixed and hydrated materials, Spraycrete assures a mix suitable for most waterproofing problems. **Western Waterproofing Company, CE 3-126, 1223 Syndicate Trust Bldg., St. Louis 1, Mo.**

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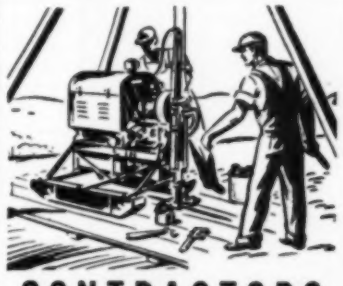

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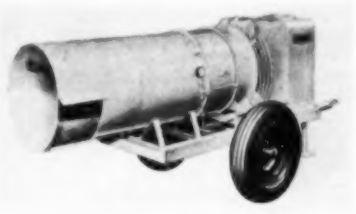
Equipment, Materials & Methods (Continued)

Mobile Heater

A LARGE MOBILE heater for drying and curing concrete, cement, plastering, masonry and paint is announced. It has also been designed for heavy duty outdoor drying such as highways, concrete ditches, culverts and foundation work. One of the outstanding features is its ability to heat large areas completely and uniformly. This is accomplished by a compact, light weight portable machine. The Bes. D. Frostr is a blower type heater with axial fan, and is available powered by gasoline engine or electric motor. It rapidly heats and distributes warm air in a controlled pattern without creating isolated "hot spots." It lights instantly, requires no preheating, and can be used in close quarters because the flame is shielded. It is capable of producing 1 to 4 million BTU per hr. Employing low cost fuel, the odorless, fumeless, clean operation of Bes. D. Frostr makes it safe for use in confined places, with no flue required. A well-balanced machine with no protruding parts, the Bes. D. Frostr is easily maneuvered. It is quickly moved from place to place by one man; and can be towed by car or truck between jobs. It can be operated by ordinary labor after only a few minutes of instruction. During cold weather it is valuable for thawing frozen building materials, pipes and for preheating engines and equipment, as well as providing temporary heating for personnel. **Besler Corporation, CE 3-127, Oakland, Calif.**



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IN RESPONSE to the on-the-job demand for heavy duty portable cutters by steel mills and construction companies, H. K. Porter engineers have developed an all-steel tool with heat-treated tubular steel handles built to stand up under the heaviest usage. Construction companies have particularly felt the need for cutters sufficiently rugged for continuous cutting of hard concrete reinforcing rods up to $^{1}/_{2}$ in. diameter and wire rope and cable up to $^{3}/_{4}$ in. diameter. Models also available for cutting soft bolts, medium hard rods, etc. **H. K. Porter, Inc., CE 3-127, Somerville, Mass.**

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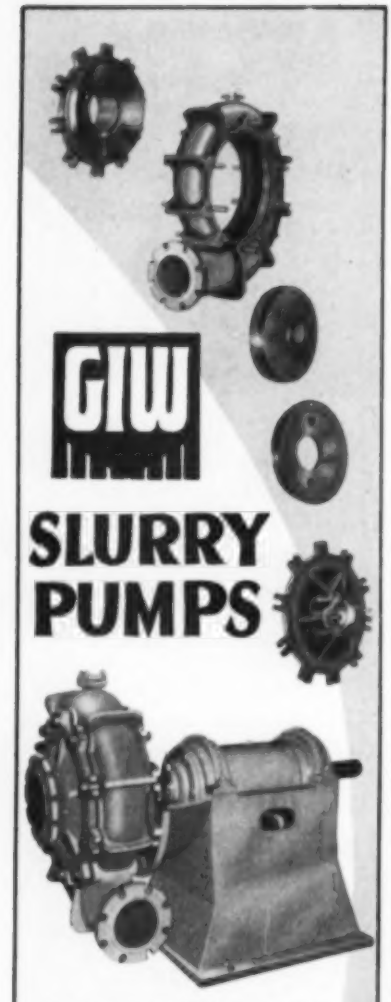

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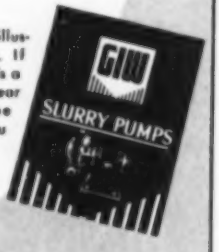

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Equipment, Materials & Methods (Continued)

Concrete Coring Drill

A PORTABLE, ELECTRIC drill that uses diamond coring bits for drilling holes in or extracting test cores from concrete structures has been developed. Holes in hard concrete are drilled easier, faster and at less cost than other methods. Many contractors, office building maintenance men, and testing laboratories are already using the drill and bits. The drill is the Penndrill Model E Drill, a complete drilling unit, including a lever operated press for advancing or retracting the bit, adapted for diamond core drilling of vertical, horizontal or angle holes, operating on either 115 or 230 volt AC or DC current. A portable electric plant, 1500 watt, 115 volt DC is furnished as optional equipment. It drills neat, clean holes from $\frac{1}{2}$ in. to $6\frac{1}{2}$ in. in diameter through concrete, reinforced concrete, marble, granite, tile, glass, brick and porcelain. **The Pennsylvania Drilling Company, CE 3-128, 1205 Chartiers Ave., Pittsburgh 20, Pa.**

Tandem Roller

VARIABLE WEIGHT, 4-6 ton, tandem rollers now have the important advantage of easy portability from job to job. This has been made possible by including a set of hydraulically-retractable, roller bearing, rubber-tire transport wheels, which permit speedy and safe towing of the roller behind any truck. Quick and easy raising of the complete roller unit off the ground is accomplished by simple fingertip hydraulic control. A built-in hydraulic jack in truck hitch raises compression roll, and the retractable transport wheels raise the steering roll. Both hydraulic operations

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Literature Available

MOWER BULLETIN—A two-color leaflet featuring the Model 72 Power-Take-Off Rotary Mower, has just been published. The bulletin, designated as W-114, gives complete details and specifications of the twin-blade rotary mower, which was designed for use on highways, parks, golf courses, private estates, parkways and institutions. **Worthington Mower Company, CE 3-129, Stroudsburg, Pa.**

CHAIN HOISTS—A complete bulletin covering the full line of recently announced P & H chain hoists is now available. Printed in two colors and illustrating each type of hoist, the bulletin includes descriptions as well as condensed specifications. It covers all types of hoists from $\frac{1}{4}$ ton up to 25 ton capacity. **Harnischfeger Corporation, Hoist Div., CE 3-129, 4400 West National Ave., Milwaukee 46, Wis.**

AIR CONDITIONER—Bulletin No. 1307, recently released, describes a Pulpit Air Conditioner designed and developed for use in industrial control areas where heat, dirt, or fumes create hazardous working conditions. The 4-page booklet lists all mechanical features of the conditioner, and presents tables of capacities and dimensions of the different evaporators and condenser sections available. **Dravo Corp., CE 3-129, 1203 Dravo Building, Pittsburgh 22, Pa.**

WATER COLUMNS—Data Unit No. 232 describes, illustrates, and gives specifications on Jerguson Water Columns. Principle of operation and features that assure positive alarm signals if boiler water falls too low or rises too high are explained. **Jerguson Gage & Valve Co., CE 3-129, 80 Fellsway, Somerville 45, Mass.**

STOCKPILE LOADER—A colorful catalog on the versatile Athey Force-Feed Hi-Loader is now available to equipment users. The well-illustrated 8-page booklet shows the HiLoader on a variety of applications and details the many features that give high production. Actual job data is presented to prove HiLoader performance. **Athey Products Corporation, CE 3-129, 5631 West 65th St., Chicago 38, Ill.**

MANGANESE STEEL CASTINGS—A general catalog, describing the complete line of castings made of "the toughest steel known" has just been released. Typical castings are shown in over 100 photographs with applications listed. There is also a complete discussion of the impact and abrasion resistant characteristics of Amsco 13 percent manganese steel under each product category. There is detailed information on power shovel dippers, teeth, chain, gears, sheaves, crusher parts, dredge and materials handling pumps, etc. **The American Manganese Steel Div., CE 3-129, 389 East 14th St., Chicago Heights, Ill.**

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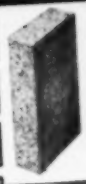

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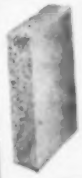

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Literature Available (Continued)

INSULATION—A 20-page Technical Data Manual, gives engineers all available information on the application of Gilsulate, a revolutionary new insulation for hot underground pipes. The Manual describes the three grades of Gilsulate available, how ditch sizes are determined for various pipes and types of soil, how the efficiency of the insulation is calculated, and how its performance for a particular job can be predicted. Numerous charts, tables, drawings and graphs are used throughout the Manual to simplify and clarify discussion of the engineer's calculations. **American Gilsonite Company, CE 3-130, 134 West Broadway, Salt Lake City, Utah**

SUMP PUMPS—Construction details, head and capacity tables, dimensions and other data are the subject matter contained in Bulletin 1029 titled "Johnson Unit-Line Sump Pumps". The Unit-Line sump pump is a pre-engineered packaged line from which a pump can be selected for existing conditions or for new construction. Bulletin is printed in color and is fully illustrated. **Johnson Pump Company, CE 3-130, 3272 East Foothill Blvd., Pasadena 19, Calif.**

AUTOMATIC FILTERS—A 12-page illustrated bulletin describing Staynew automatic filters designed for large air volume and high efficiency has been announced. The bulletin contains specifications, engineering and performance data covering automatic filters in a wide range of sizes for handling any desired air capacity. **Dollinger Corporation, CE 3-130, 11 Centre Park, Rochester 3, N. Y.**

POWER DRIVER—A 4-page bulletin issued pictures and describes details of the design, operation and numerous applications for the Velocity-Power Model "P" Driver, a new model of a portable power-actuated tool for driving steel studs into steel, concrete or masonry, and for other work. The bulletin also serves to announce that the Driver is listed and approved by Underwriters' Laboratories, Inc., indicating its safety-engineered design. **Velocity-Power Tool Company, CE 3-130, 201 North Braddock Ave., Pittsburgh 8, Pa.**

AERIAL PHOTOGRAPHY—A new and extensively revised fourth edition of the Data Book "Kodak Materials for Aerial Photography" has just been published. Generally acknowledged as one of the standard reference works for all aerial photographers, the book has now been revised in detail to bring all sections up to date and to provide the latest data for professional aerial picture taking. Of particular interest to readers will be data on the high-speed Kodak infrared aerographic film recently made available by Kodak for maximum penetration of haze and for other special purposes. Copies priced at .50¢. **Eastman Kodak Company, CE 3-130, Rochester 4, N.Y.**

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November

321. **Erection of the Main River Span, Passaic River Crossing, New Jersey Turnpike,** by Jonathan Jones. (ST)

322. **Design of Frames by Relaxation of Yield-Hinges,** by J. Morley English. (ST)

323. **Stabilization of Soil by Silt Injection Method,** by George E. Johnson. (SM)

324. **Pile Loading Tests, Morganza Floodway Control Structure,** by Charles I. Mansur and John A. Focht, Jr. (SM)

325. **Building Foundations in San Francisco,** by Charles H. Lee. (SM)

326. **Foundation Exploration—Denver Coliseum,** by R. B. Peck. (SM)

327. **A Concept of Slope Design of Ertha Dam Embankment,** by C. Y. Li. (SM)

328. **Trafficability of Soil as Related to Mobility of Vehicles,** by R. C. Stewart and S. J. Weiss. (SM)

329. **An Interstate Route and Its Urban Connections,** by D. W. Ormsbee. (HW)

330. **Plastic Deformation of Wide-Flange Beam-Columns,** by Robert L. Ketter, Edmund L. Kaminsky, and Lynn S. Beedle. (EM)

331. **Deflection of Laminated Beams,** by L. G. Clark. (EM)

332. **Post-Buckling Strength of Redundant Trusses,** by E. F. Masur. (EM)

333. Discussions of PROCEEDINGS-SEPARATES 177, 179, 202, 223, and 258. (EM)

334. **Lateral Buckling of Channels and Z-Beams,** by H. N. Hill. (EM)

335. **Water Pollution Control Policy,** by Paul D. Haney. (SA)

336. **Performance of Biofiltration Plants by Three Methods,** by R. S. Rankin. (SA)

337. **Future Developments in Sanitary Engineering,** by Harold B. Gotaas. (SA)

338. **Administration: The Key to Effective Application,** by Vinton W. Bacon. (SA)

339. **The Need to Break with Tradition,** by Ray L. Derby. (SA)

340. **Health, Welfare and Development,** by John A. Logan. (SA)

341. **What's the Outlook for Sanitary Engineers?** by Clarence W. Klassen. (SA)

342. **The Problems of Civil and Structural Design of Steam Electric Plants for the Pacific Gas and Electric Company in Central California,** by W. L. Dickey. (CO)

343. **Design and Research for Welded Structures,** by LaMotte Grover. (ST)

344. **Steel for Welded Bridges and Buildings,** by Simon A. Greenberg. (ST)

345. **Fabrication and Construction of Structural Steel for Buildings,** by C. L. Kreidler. (ST)

346. **Statutory Control of Ground Water,** by S. T. Harding. (IR)

347. **Use of Colorado River Water in California,** by Raymond Matthew. (IR)

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352. **Concepts of Engineering Biotechnology in Occupational Health,** by Alvin F. Meyer, Jr. (SA)

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359. **Development of Miami International Airport,** by Earle M. Rader. (AT)

360. **Strength Characteristics of Compacted Clays,** by Gerald A. Leonards. (SM)

361. **Pressure Surge Control at Tracy Pumping Plant,** by John Parmakian. (HY)

362. **Graphical and Theoretical Analysis of Step-Drawdown Test of Artesian Well,** by M. I. Rorabaugh. (HY)

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367. Discussions of PROCEEDINGS-SEPARATES 151, 172, 173, and 174. (SU)

368. Discussions of PROCEEDINGS-SEPARATES 148 and 166. (WW)

369. **Unsteady Flow in Open Type Pipe Irrigation Systems,** by E. H. Taylor, A. F. Pillsbury, T. O. Ellis, and G. A. Bekey. (IR)

370. Discussions of PROCEEDINGS-SEPARATES 172, 173, and 174. (AT)

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373. Discussions of PROCEEDINGS-SEPARATES 150, 170, 245, and 306. (ST)

374. Discussions of PROCEEDINGS-SEPARATES 157, 202, 223, 299, and 300. (EM)

375. **Deflections of a Circular Beam Out of Its Initial Plane,** by Enrico Volterra. (EM)

376. **Electrical Analogs of Statically Loaded Structures,** by Frederick L. Ryder. (EM)

377. Discussions of PROCEEDINGS-SEPARATES 130, 208, and 231. (SA)

378. Discussions of PROCEEDINGS-SEPARATES 160, 162, 294, and 308. (PO)

January

379. Discussions of PROCEEDINGS-SEPARATES 155 and 215. (SM)

380. **Master Library List of Fluid Mechanics and Hydraulic Engineering Titles: Progress Report of the Committee on Research of the Hydraulics Division.** (HY)

381. **Open Channels with Nonuniform Discharge,** by Wen Hsiung Li. (HY)

382. **Hydraulic Model Studies of Martin Dam Draft Tubes,** by Carl E. Kindsvater, and R. R. Randolph, Jr. (HY)

383. **Backwater Functions by Numerical Integration,** by Clint J. Keifer and Henry Hsien Chu. (HY)

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388. **Water Supply Engineering: Report of Committee on Water Supply Engineering of the Sanitary Engineering Division for the Period Ending September 30, 1953.** (SA)

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396. Discussions of PROCEEDINGS-SEPARATES 185, 223, 250, 258, and 281. (EM)

397. Discussions of PROCEEDINGS SEPARATES 158, 183, 187, 201, and 219. (ST)

February

398. **Economic Effect of Irrigation in a Subhumid Area,** by Willis C. Boegli. (IR)

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American Cast Iron Pipe Company 25
American Concrete Pressure Pipe Association 28
American Pipe and Construction Co. 23
American Steel & Wire Division . . . . . 108 and 109
Armco Drainage & Metal Products, Inc. 97
Austin-Western Company 29

Barber-Greene Company 113
Barco Manufacturing Company 15
C. L. Berger & Sons. 2
Bludworth-Marine, Division of National-Simplex-Bludworth, Inc. 106
Brown & Brown, Inc. 125

Cast Iron Pipe Research Association . . . . . 12 and 13
Caterpillar Tractor Co. . . . . 83 and 84
Cement Gun Company 124
Chicago Bridge & Iron Company 35
Clipper Manufacturing Co. 105
Columbia-Geneva Steel Division . . . . . 108 and 109

Drilled-In Caisson Corporation 123

Eastman Kodak Company 87
The Eberhard Faber Pencil Company. . . . . 33 and 34
Eimco Corporation . . . . . 20 and 21

Fairchild Aerial Surveys Inc. 112
Fennel Instrument Corp. of America 119
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General Electric Company 4
Georgia Iron Works 128
Great Lakes Steel Corporation 31
Griffin Wellpoint Corp. 100

Hardinge Company, Incorporated 125
Rodney Hunt Machine Co. 3

International Harvester Company . . . . 101, 102, 103 and 104
Irving Subway Grating Co., Inc. 117

Joy Manufacturing Company 19

Laclede Steel Company 116
Layne & Bowler, Inc. 9
The James Leffel & Co. 18
Leupold & Stevens Instruments, Inc.. 117
Link-Belt Company 6
Lock Joint Pipe Company . . . . . 4th cover
Lone Star Cement Corporation 38

The Master Builders Co. . . . . 3rd cover
Moretrench Corporation 37

National Clay Pipe Manufacturers, Inc. 1
National Pool Equipment Co. 121
Naylor Pipe Company 111

The Permutit Company 36
Philadelphia Gear Works, Inc. 22
Phoenix Bridge Company 127
Pittsburgh-Des Moines Steel Co. 14
Portland Cement Association 24

Raymond Concrete Pile Co. . . . . 2nd cover
The Ronald Press Company 126

Sauerman Bros., Inc. 120
Servicised Products Corp. 129
Sika Chemical Corp. 118
Simplex Valve and Meter Company 107
S. Morgan Smith Co. 27
Sonoco Products Company . . . . . 98 and 99
Spencer, White & Prentis, Inc. 125
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Stran-Steel Division 31
Structural Clay Products Institute 30
Superior Concrete Accessories, Inc. 26

Tennessee Coal & Iron Division . . . . . 10, 108 and 109
Thompson Pipe & Steel Co. 126

Union Metal Manufacturing Co. 8
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Universal Concrete Pipe Co. 128
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United States Steel Corp. . . . . 10, 32, 108 and 109
United States Steel Export Company . . . 10, 108 and 109

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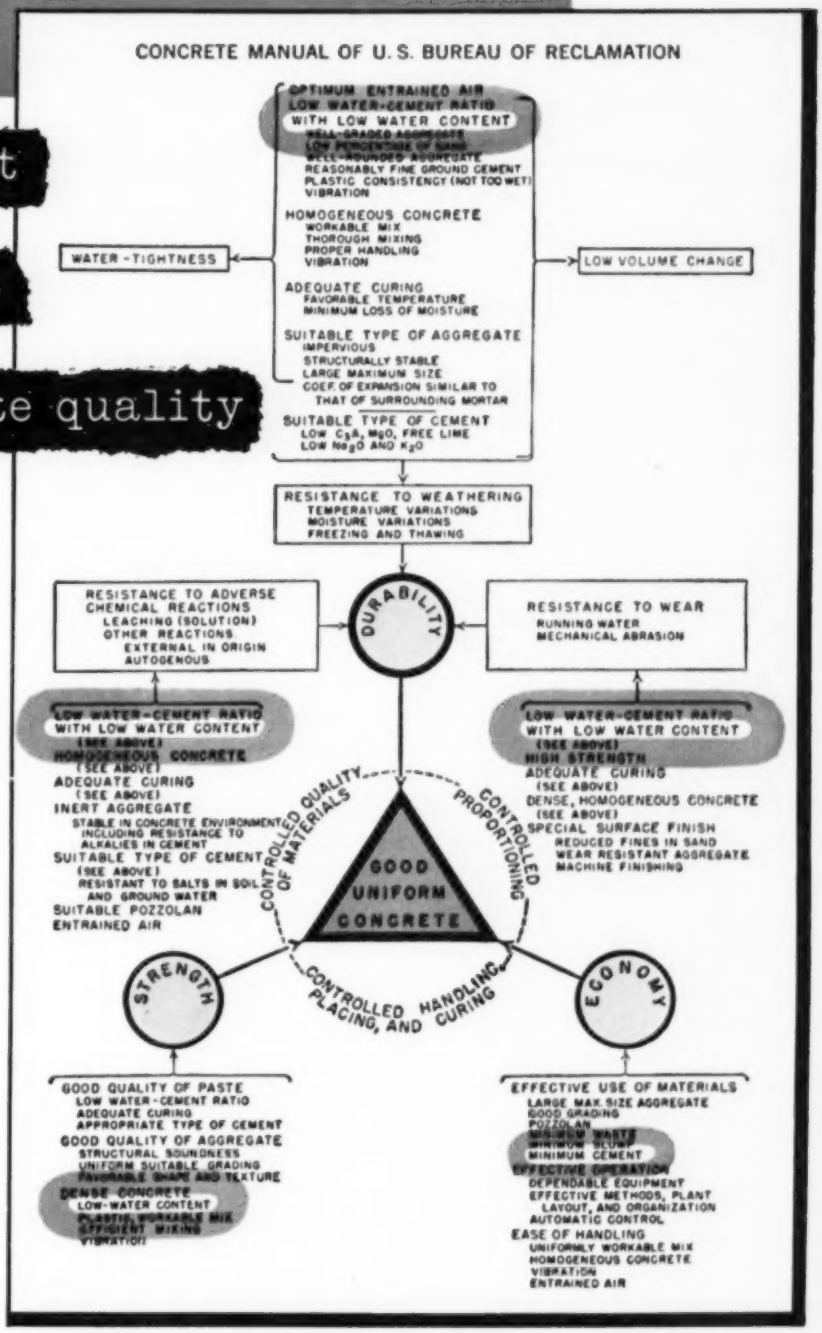

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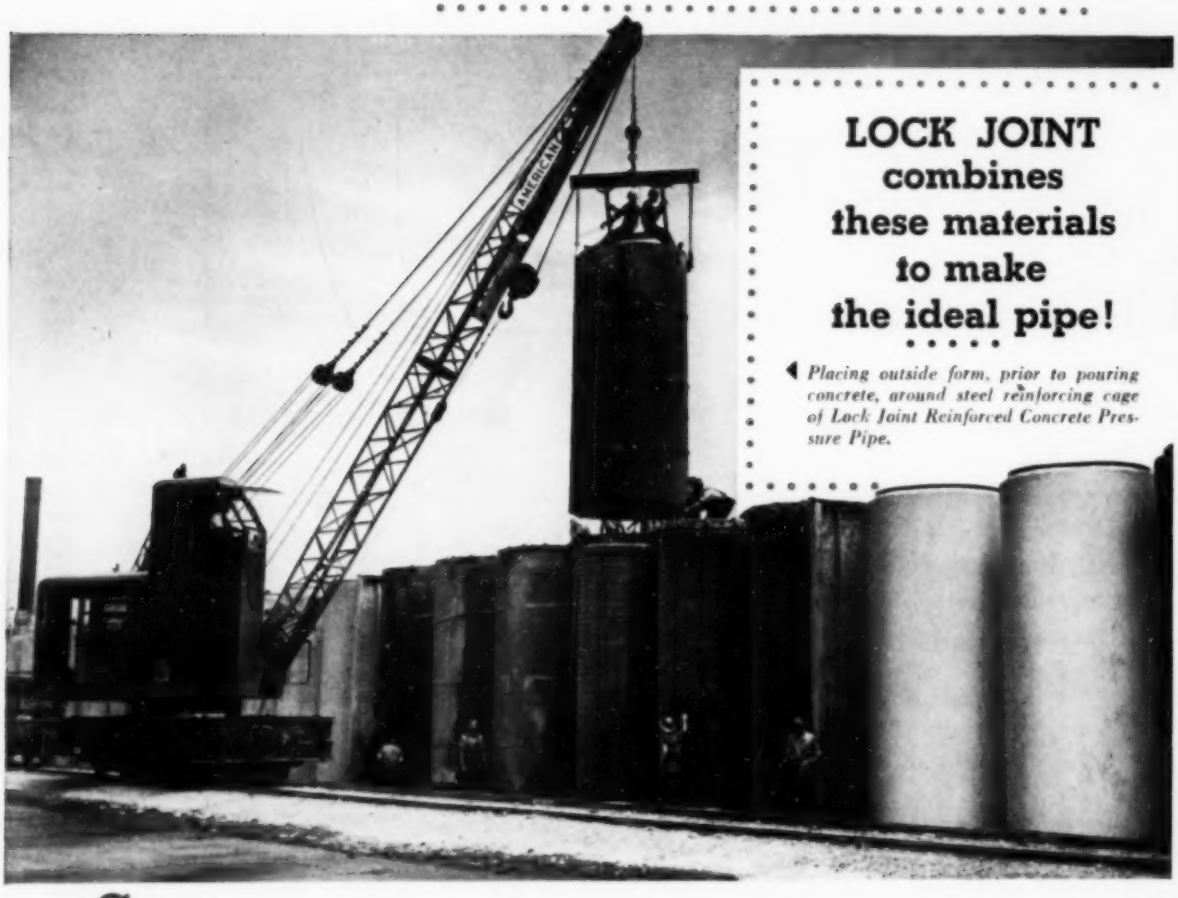

LOCK JOINT combines these materials to make the ideal pipe!

Placing outside form, prior to pouring concrete, around steel reinforcing cage of Lock Joint Reinforced Concrete Pressure Pipe.

CONCRETE, with its proven qualities of durability, non-corrosion, resistance to electrolytic action, and high compressive strength is combined, by Lock Joint, with steel's toughness, resilience and high tensile strength to make a pipe that retains the best qualities of both—non tuberculance, high structural strength and long life with little or no maintenance. Dense concrete affords complete protection for the quality reinforcing steel. Both materials are carefully calculated to meet your pressure needs with a wide factor of safety. The Lock Joint Pipe Company's Rubber and Steel Joint is extremely watertight and, at the same time, flexible.

For superior strength, carrying characteristics and trouble-free operation, let Lock Joint supply your pipe needs in sizes 16" and larger.

SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains 16" in diameter or larger, as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.*

LOCK JOINT PIPE COMPANY

Established 1905

P. O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich., Columbia, S. C.

SEWER & CULVERT PIPE PLANTS:

Casper, Wyo. • Cheyenne, Wyo. • Denver, Col. • Kansas City, Mo. • Kennett Square, Pa. • Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. Kenilworth, N. J. • Hartford, Conn. • Tucumcari, N. Mex. • Oklahoma City, Okla. Tulsa, Okla. • Beloit, Wis. • Hato Rey, P. R. • Ponce, P. R. • Caracas, Venezuela

LOCK JOINT
Reinforced Concrete
PRESSURE PIPE